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CONTENTS.

Editorial 279
The First Direct New York Cable 281
The Feeder and Main Patent 284
How to Make a Voltmeter and an Ammeter—For Amateurs, by G. E. Dunton 285
Harmonic Call Bells, by S. D. Mott 287
Rope Driving—X., by J. J. Flather 288
Dynamo-Electric Machinery—VIII., by E. J. Houston and A. E. Kennelly 289
The Earth as an Electrical Conductor, by J. H. Holt 290
Engineering Education and State Universities, by W. S. Aldrich 290
The Sine Curve Controversey 291
The Sine Form of Curves of Alternating E. M. F., by A. Blondel 292
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 294
New Book 296
Electric Lighting on Coal Boats 297
A New Search Light 297

DEPARTMENTS:

Financial Intelligence 298
Special Correspondence 299
News of the Week 299
Trade and Industrial Notes 300
Business Notes 301
Illustrated Record of Electrical Patents 301

A PROMISING SUGGESTION.

Elsewhere in this issue, Mr. S. D. Mott describes a principle for the construction of a new and very neat substitute for the electric bell or buzzer, whose practical realization offers an opportunity for an interesting experiment. Such a device would be sightly in appearance and its sound would be a great improvement over that of the present forms of bells and buzzers. In some forms of chronographs a definite rate of vibration is obtained through the making and breaking of a current by a tuning fork, one arm of which is attracted by a magnet at the make and released at the break, the fork being thus set in vibration. A steel spring may be used instead of a tuning fork, and would seem to be preferable, as by moving an adjustable weight along its length its period of vibration may be adjusted within wide limits and thus be made to correspond to the period of the receiving device instead of making the latter accord with a tuning fork. For experimental purposes two tuning forks of the same rate of vibration, one acting as receiver and the other as interrupter, could be used. For practical use two weighted springs might be substituted, as these could both easily be tuned in acccord with each other and to the pitch of musical note. The experiment would be an interesting and inexpensive one and is well worth making.

THE FEEDER AND MAIN DECISION.

In another column we give an abstract of the opinion of Judge Acheson on this important suit, which reverses the previous decision rendered by Judge Green and nullifies the Edison feeder and main patent. The result was not unexpected, or, at least, little weight was given in electrical circles to the opinion of Judge Green, which was remarkable in several respects aside from its legal one. The learned judge in his attempt to be scientific was little less than ludicrous, and it may be that an appreciation of this fact by the higher court accounts for its somewhat contemptuous treatment of Judge Green's opinion. As will be seen, the decision adverse to the patent is based upon two grounds; first, that the principles involved had long previously been employed in electroplating and was also ante-dated in Khotinsky's patent of 1875, and second, that the plan of distribution covered by the claims in question is not "the creative work of that faculty which it was the purpose of the Constitution and the patent laws to encourage and reward." It is denied that the patent in suit solved the problem, as claimed, of economically supplying lighting currents to circuits covering large areas, portions of which are at a great distance from the source of electrical energy. On the contrary it is asserted that the problem only involved the exercise of common skill and knowledge on the part of the electrician, and it is implied that the principle would have been as a matter of course taken advantage of, when, shortly after, the commencement of the growth of electric lighting brought forth the occasion of its use. As the feeder and main principal had been for years treated almost as public property, the effect of the decision on General Electric profits will be negligible, and had the patent been annulled a year earlier considerable feeling due to recent suits against minor firms on an alleged forced construction of the patent would have been avoided

SINE FORM OF CURVES OF ALTERNATING E. M. F.

We reprint elsewhere in this issue the reply of the London Electrician to the numerous criticisms which have appeared in our columns directed at our esteemed contemporary's dicta in regard to the uselessness of the sine form of alternating E. M. F. The two statements in particular to which our correspondents have taken exceptions are as follows: "The elaborate attempts which are being "made by some of the American alternator builders to give this

"property (of generating sine E. M. F.'s) to their machines are "utterly useless and a complete waste of time and energy," and "we "would not be surprised to find that the sine curve should be "carefully avoided, and that the best curve is of a very different "shape." Before commenting upon the reply of the *Electrician* we will recapitulate briefly the evidence thus far presented in favor of and against the sine curve. Professor Rowland in an article in The Electrical World of December 10, 1892, for the first time, as far as we know, referred to the injurious effects of the harmonics always present in non-sinusoidal E. M. F's. He pointed out that they were the cause of losses, though small, in transformers, but of serious deleterious effect in power transmission, and it was pronounced "of the first importance in the transmission of power that the "curves shall be pure sine curves, and dynamos, transformers and "motors must be designed in the future with reference to this point." We shall refer later on to the conclusion of Professor Rowland in the same article on the effect of harmonics in hysteresis. As bearing on the same point, Mr. John F. Kelly in the discussion which has recently appeared in our columns, gives an instance of a 40-h. p. motor that was practically inoperative when driven from an alternator with very irregular waves. Dr. Duncan quotes Mr. C. F. Scott as authority for a somewhat similar case, and Messrs. Houston and Kennelly refer in general terms to the deleterious motor reactions produced by harmonics. Mr. Steinmetz and Dr. Bell ascribe the deleterious reaction as a property of the two-phased motor, and the former states that the third harmonic does useful work in three-phased motors; Professor Blondel, however, says that the effect of that component is nul in synchronous motors. In view of these opinions a general denial of this reactive torque, such as is implied in the comment of the *Electrician*, or the assertion that the examples adduced in its favor prove nothing, merely evade the question. As to the loss from the C^2R effect of reactance currents incident to non-sinusoidal E. M. F.'s, Messrs. Rowland, Kennelly and Houston, Fessenden, Ryan and Blondel all lay stress upon the importance which it may assume. We may add that in a case which came under our observation, the volt ampere current to run an induction motor was 7 amperes when the equivalent current in phase with the E. M. F. was only 1.8 amperes. Prof. Ryan in this connection makes the interesting statement that there will be no reactance current if both the generator and motor have an E. M. F. of exactly the same form, to which Prof. Blondel assents. Since this identity should exist, at least approximately, the query of Professor Ryan is much to the point—"Is there any form for a standard which presents more "advantage and introduces fewer constructional difficulties or ex-"penses than the sine form?" In regard to the greater loss from eddy currents with non-sinusoidal E. M. F.'s, all are agreed and no denial is entered by the *Electrician*. Nor does our contemporary specifically deny that the inductive drop of lines is thereby increased, though statements of Messrs. Houston, Kennelly and Dunbar involving this point are somewhat captiously criticised. This effect to our mind, is one of the most important; from its practical bearing on electric lighting, for inductive drop with sine currents on lines with small capacity is itself a sufficient evil without being further augmented by the use of non-sinusoidal E. M. F.'s, which besides will be still less affected by capacity. Thus far the evidence has all strongly inclined to one side of the question, but when we come to hysteresis it is different. Prof. Rowland, in the article above referred to, states that the effect of harmonics on hysteresis is complicated, but after discussing the question from two different hypotheses he concludes that "It would seem, then, that the "losses due to hysteresis and current heating may be much increased "by the harmonics." Messrs. Houston and Kennelly, Dunbar and, Fessenden positively state that the hysteresis loss is increased with non-sinusoidal currents. Messrs. Bell, Ryan and Kelly refer to the increase of iron losses, which may either imply that there is a loss from hysteresis, or that the increase of the eddy loss is greater than the reduction, if any, in the iron loss from hysteresis. Steinmetz, on the other hand, asserts that a peaked E. M. F. curve reduces the hysteresis and gives strong reasons in support, and owing to the weight of his authority, this branch of the subject may be considered an open one, as it is apparently assumed to be by Professor Blondel. It may be pointed out, however, that this advantage, if it exists, does not apply to flat-topped curves of E. M. F., in which the hysteresis would be greater than in the sine form, and that with the peaked curve the advantage would not necessarily apply in all cases, owing to the increase of eddy loss in some instances probably overbalancing the hysteretic gain. This latter consideration may be the explanation of the resultant loss found by Prof. Ryan and Dr. Bell, assuming the correctness of the principle laid down by Mr. Steinmetz. On the same assumption, the experiments quoted by Mr. Steinmetz seem merely to point out the resultant gain by hysteresis and therefore do not imply the absence of losses from reactance and foucault currents, and do not touch upon line losses or drop at all. Prof. Blondel points out the danger from resonance with non-sinusoidal currents, which Mr. Steinmetz admits with the statement that a line which is liable to give rise to such a danger from resonance is not fit for use with the fundamental wave either. In reply to the various views and statements we have thus briefly outlined, our contemporary exposes the weakness of its position by the manner in which it treats the evidence presented. In regard to the case quoted by Dr. Duncan, it states that "it only shows that "one particular non-sine curve was worse than the sine curve with "one particular motor," thus entirely evading the general principle of harmonic motor-reaction which is really the issue. The statement "Finally, we would remark that since the flat-topped "curve is best for general distribution purposes, best for transformer "and generator efficiency, and as good, at least, for lighting purposes "by glow lamps, and, if we understand Herrn Rossler and Wedding "aright, better than a sine curve or a peaked curve for arc lamps "it is therefore to the interests of makers to cultivate this type "of curve," is, to put it mildly, a surprising one. In the first place the arguments which our contemporary uses refer to the peaked and not to the flat-topped curve of E. M. F., as it itself acknowledges in the succeeding issue. No argument whatever is adduced or even referred to that supports the claim of the superiority of any non-sinusoidal curve for general distribution purposes or for generator efficiency. It only grants the sine curve to be "as good, at least, "for lighting purposes by glow lamps," thus giving least weight to the strongest argument against it, and the only one for which it brings forth any support. Finally, in direct contradiction, Herrn Rossler and Wedding state, "The sine current gives the best results; "the development of light is fair, and the arc is silent." At the present stage of this interesting controversy it may be fairly said, we believe, that, even assuming a reduction of hysteresis with a peaked curve, the sine curve is in general best for the reasons that with it line drop, reactance currents, resonance, and eddy losses have minimum values; reactive torque in motors is absent or reduced and the disagreeable humming of arcs is avoided, which latter is an advantage of a most important practical character. It offers itself as being the simplest form for the standard which is desirable, not only on account of the identity which should exist in the characteristics of generators and motors working together, but also from allowing results to be predicted with more precision than is otherwise possible. Its general adoption would obviate the necessity of adjusting alternating arcs to each machine with which they are used, and thus placing them at a disadvantage with direct current arcs. To quote Professor Blondel, "The employment of a sine E. M. F. can never "be injurious; it is always to be recommended with a view to "precision, and is often indispensable; in certain cases it assures an "important superiority of efficiency; in others this superiority is "practically negligible. Under very frequent circumstances, "in particular where transformers are employed, the realization of "a sine E. M. F. is absolutely visionary, ulterior causes deforming "the secondary in such a manner as to render entirely useless most "often the efforts made to obtain the sine form in the generat-"ing machine." The latter cases, however, unless questions of cost or expedience intervene, would seem to give no reason for discriminating against the sine form.

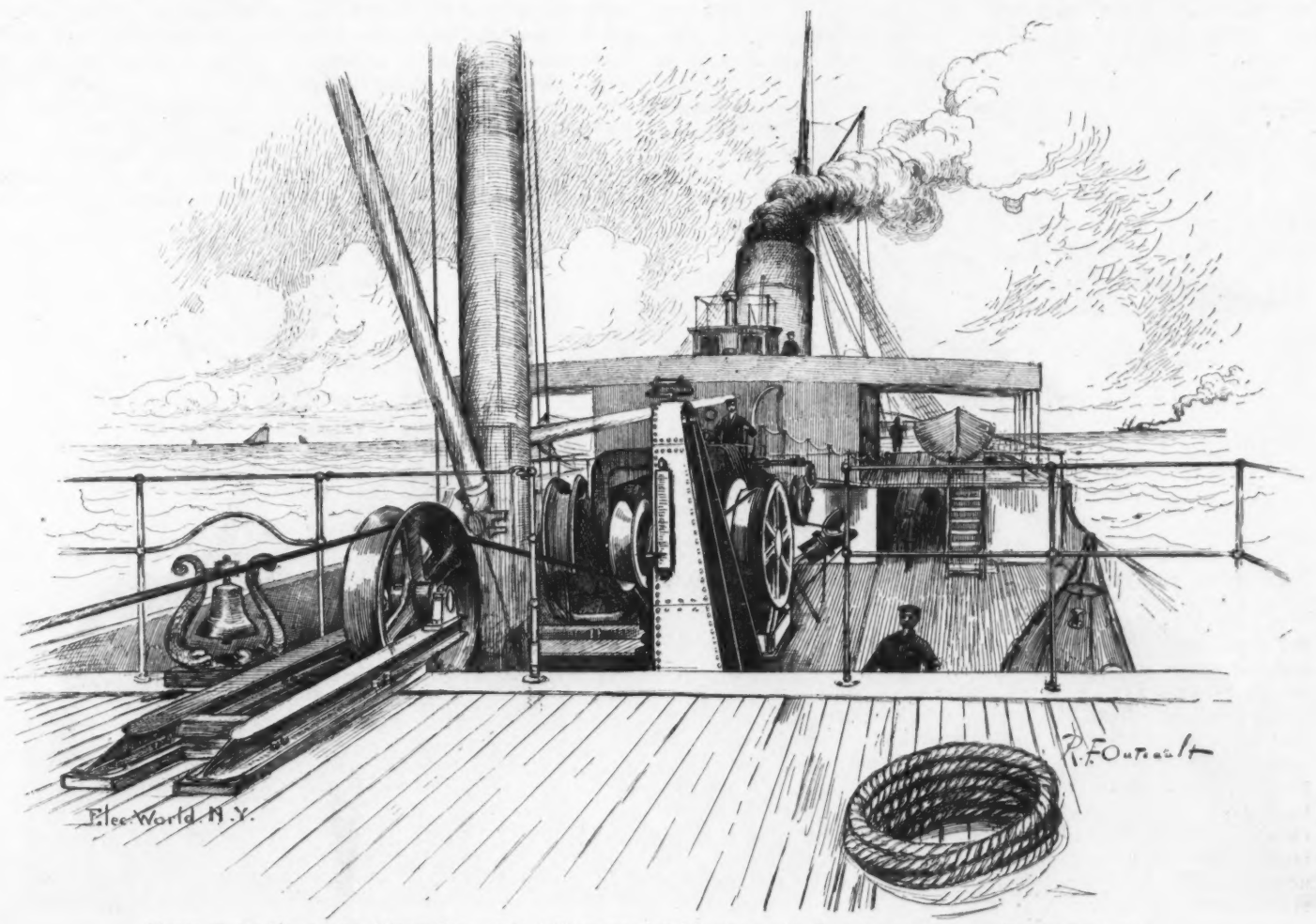
The First Direct New York Cable.

TO have an Atlantic cable landed 2,000 miles away from New York was thought a great thing in 1866, and in 1856, when Mr. Cyrus W. Field organized the first Atlantic cable company, it is quite presumable that he never even thought that a cable connecting the Old World and the New would be brought directly into our great metropolis. But the time has come when such is actually the case. With the laying of the Commercial Cable from its former terminus at Manhattan Beach, Coney Island, to Pier A at the Battery, on September 1st and 2d, New York was placed in direct communication with the heart of Europe. There is probably no similar city in the world that enjoys such great advantages as New York now has with the completion of this work. The Commercial Cable Company's system is so perfect that it is said that a question could be asked of London and an answer received inside of three minutes.

It will probably be interesting to many of our readers to describe the process by which this great work of cable laying is done. Through the courtesy of Mr. George G. Ward, vice-president of the Commercial Cable Company, the representative of The Electrical World, accompanied by its special artist, was invited to be on board of the ship while the work was being completed.

On Saturday, September 1st, the tug boat "Stranahan" was engaged to lay about five miles of the inshore cable from Manhattan Beach to a point opposite Norton's Point, New York Harbor, the cable steamer "Mackey-Bennett" drawing too much water to undertake this part of the work. This was successfully accomplished and the location of the end of the cable was marked by making a buoy fast to it before lowering it into the water. At 7.30 the next morning, Sunday, September 2d (Sunday having been selected because the harbor is free from the usually heavy traffic), the tug "William J. McCaldin" called at the Marine Club wharf and took on board the favored few, from whence they were transported to the "Mackey-Bennett" lying off Norton's Point. Among the visitors aboard the vessel were John W. Mackey, Jr., director of the Commercial Cable Company; E. Lambert Lynch; G. H. Usher, assistant superintendent of the Postal Telegraph-Cable Company; T. L. Cuyler, Jr., assistant treasurer of the Postal Telegraph-Cable Company; J. H. Smart, assistant superintendent of the Commercial Cable Company; J. H. Emmerich, superintendent of the Postal Telegraph-Cable Company and Charles Cuttriss, chief electrician of the Commercial Cable Company.

The end of the cable had been brought aboard the ship and the operation of splicing the cable laid on Saturday to the remainder in the tanks of the vessel was going on. The armor and insulation was first removed from the core of the cable, which, in this instance, was composed of four conductors, each being made of seven small copper wires. These cores are thoroughly cleaned and the ends nicely scarfed and soldered together. The joint is then wound with fine copper wire which is also firmly soldered to the core wire. The acid used in soldering is then thoroughly washed off and the gutta percha insulation replaced. The inner armor wire is then put in position and served with fine twine. This completed, the protecting armor is replaced and served with "marline," or "spun yarn" as the sailors choose to call it, soaked in tallow, completing the splice. It is practically the same size as the rest of the cable, and the joint can only be distinguished from the original cable by the outer wrapping. The officers on board the boat assert that they have never known a cable to break at the splice, which is proof of the care taken in making the joint.

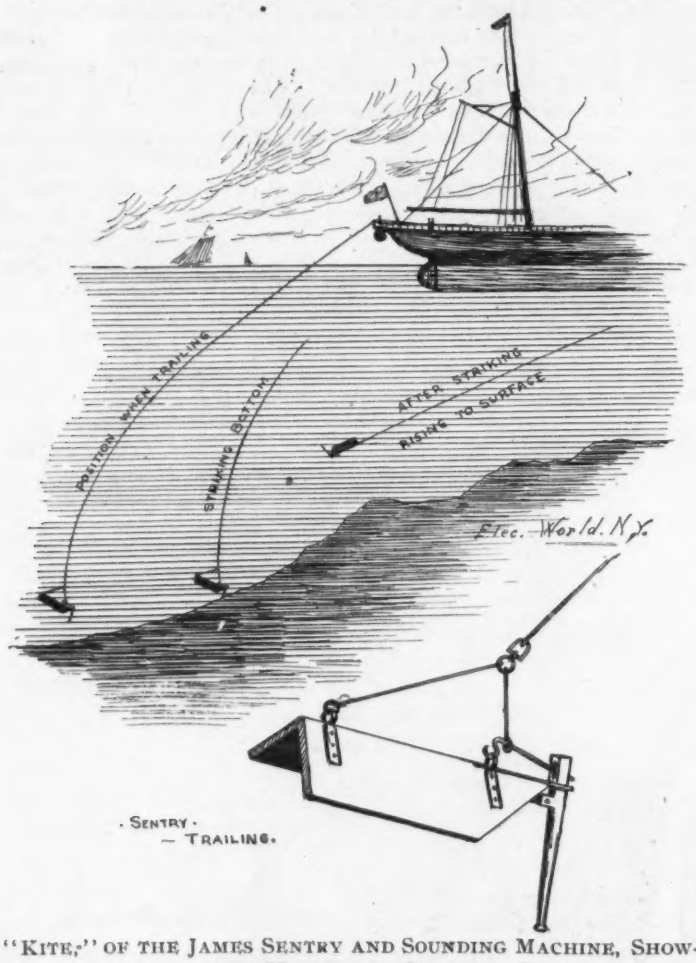


VIEW FROM FORWARD DECK SHOWING "PAYING-OUT MACHINE:" DYNAMOMETER IN FOREGROUND.

In order that the reader may become more fully acquainted with the work, a brief description of the "Mackey-Bennett" is here given. The boat is built of steel and is 270 feet in length; with 40 feet beam, and 26 feet depth of hold. She has two compound condensing engines of 450 I. H. P. each, and under normal conditions can make about 12 knots per hour. Her coaling and fresh water

capacity is sufficient for a six weeks' cruise. She is lighted through out by electricity. Search lights are provided so that cable operations can be carried on at night. Twin screws and steam steering apparatus render her manœuvering qualities excellent and make it possible to turn in her own length. A bow rudder is provided for efficient steering when going astern. Refrigerating apparatus has been installed, carbon dioxide being the cooling medium instead of the usual ammonia process.

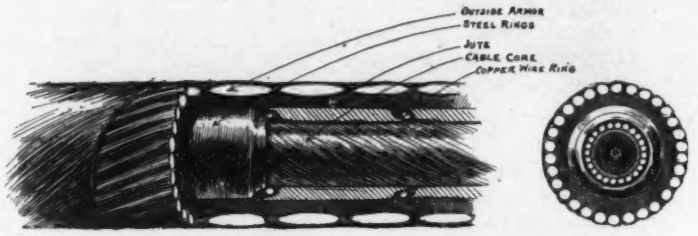
In the hold there are three immense iron tanks, 34 feet in diameter, for the storage of cable, each having a conical core for guiding the cable when it is being paid out. The space within these cores is utilized to hold fresh water. The capacity of the tanks is about 1,400 tons of cable, this being the equivalent of about 100 miles of inshore cable weighing 14 tons to the mile. The weight, however, varies according to the location. Cables in shallow water are made with heavy armor and insulation, while the deep sea cable is quite light. Special cable has to be used in the region about Halifax, owing to the grounding of icebergs. This is shown in one of the illustrations and is composed of the usual core with an armature of steel rings which are in turn covered with the outside armor. The diameter of this cable is about two and three-quarters inches and it is so strong that when an iceberg bears upon it the ice is crushed before any injury is done to the conductors. The cable tanks are all connected by "ways" or troughs so that a transfer may be made from one tank to another or from any tank to either one of the paying-out machines. Any handling of the cable made necessary by such transfers is usually done by means of a small Brotherhood engine connected to a drum and all mounted on a truck by which it may be moved about the deck.



"Kite," of the James Sentry and Sounding Machine, Showing Method of Operation.

Returning to the description of the ship, there are two paying-out machines, one of which is partially shown in the illustration. They are made up of massive gears operated by double cylinder engines set at an angle of 90 degrees to each other, making it out of the question to have both engines get on dead centre at the same time. The gears operate a large drum which controls the speed of the cable in the operation of laying or hauling in when making repairs. The operation of the machine is controlled from a platform conveniently located above the gears and from which the scale of the dynamometer is in plain view. The latter is shown in the cut, and consists of a massive iron upright, the upper portion of which forms a guide for the cable sheave. The strain is measured by a heavy coil spring in tension, and the movement of the sheave is made steady by the action of a piston working in a cylinder containing glycerine, the piston being connected to the sheave by the usual piston rod and yoke.

At either end of the boat and projecting out several feet, are self-adjustable sheaves about five feet in diameter, over which the cable passes when being lowered into the water. Surrounding these sheaves are iron platforms upon which the commanding officer stands while the cable is being laid. At the stern of the boat is a "James submarine sentry and sounding machine." It consists of a device, shown in one of the illustrations, known as the "kite" which is attached to a piano wire wound upon the drum of the sounding machine. It is used as a sentry when working in uncertain water or



Protected Cable for Use in Region of Icebergs.

when it is desired to have the cable laid in water not shallower than a depth decided upon beforehand. The manner of operation is quite clearly shown in the cut. The "kite" when set, dives immediately under the stern of the boat to the minimum depth desired. Should the boat sail into shallower water than desired, the lever at the lower end of the "kite" strikes the bottom, releasing the tow line at one end, thereby changing the position of the "kite" which immediately rises to the surface. At the moment of release the tension upon the tow line is suddenly decreased and causes a bell on the machine to ring and also one on the navigating bridge.

Located in convenient places about the ship are several electric telegraph signaling machines made by Elliott Brothers, of London.

Hatch over Cable Tank Showing Cable Guides.

Some are for communicating with the engineer of the paying-out machines, while others are for signaling the engineer of the ship.

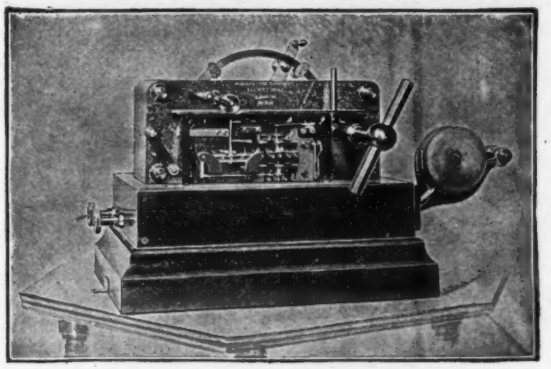
The testing room, located on the forward deck, has been thoroughly equipped with the finest of electrical measuring instruments. There is a complete set of instruments for each of the several tests required in locating faulty insulation, doing away with the necessity of changing connections. This department is in charge of Mr. C. Priest, electrician of the ship.

As the cable is brought from the tank it passes through an iron ring immediately over the centre of the hatch, thence around a

deeply grooved iron guide, and the friction of the cable at this point acts as a tension; it then passes several times around the drum to the paying-out machine and underneath the pulley of the dynamometer, over several pulleys on the deck and out over the sheave at the bow or stern to its final resting place at the bottom of the sea.

It is sometimes preferred to lay the cable from the bow of the boat, as it is a more advantageous point from which to direct the work.

The cable, in passing under the dynamometer pulley, is considerably depressed, and as the strain increases or decreases, a pointer at each side passing over graduated scales fastened to the uprights indicates the strain in tons. The strain upon the cable ranged from 2 to 3 tons and in no instance was it allowed to reach more than 10 tons for the type of cable which was used.

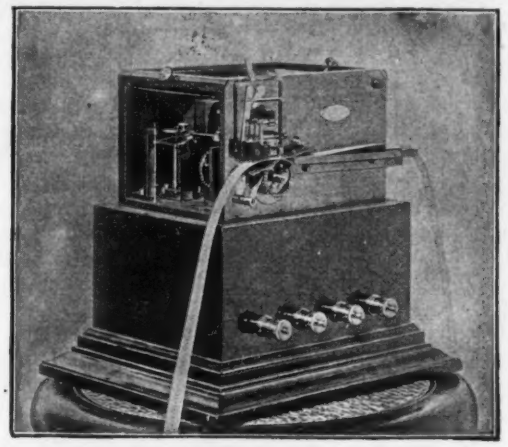


WILMOT AUTOMATIC TRANSMITTER.

The cable can be laid at the rate of 6 to 8 miles per hour, but the speed with this cable was but about 3½ miles, pier "A" being reached shortly after one o'clock Sunday afternoon. Upon reaching its destination the cable was cut and the end securely fastened to the dock. The following morning the splice was made to the underground cable recently laid from the pier to the office of the company, corner of Broad and Wall streets, completing a work that will be invaluable to the business interests of New York.

A brief description of the various apparatus employed in sending and receiving cablegrams may prove of interest at this time.

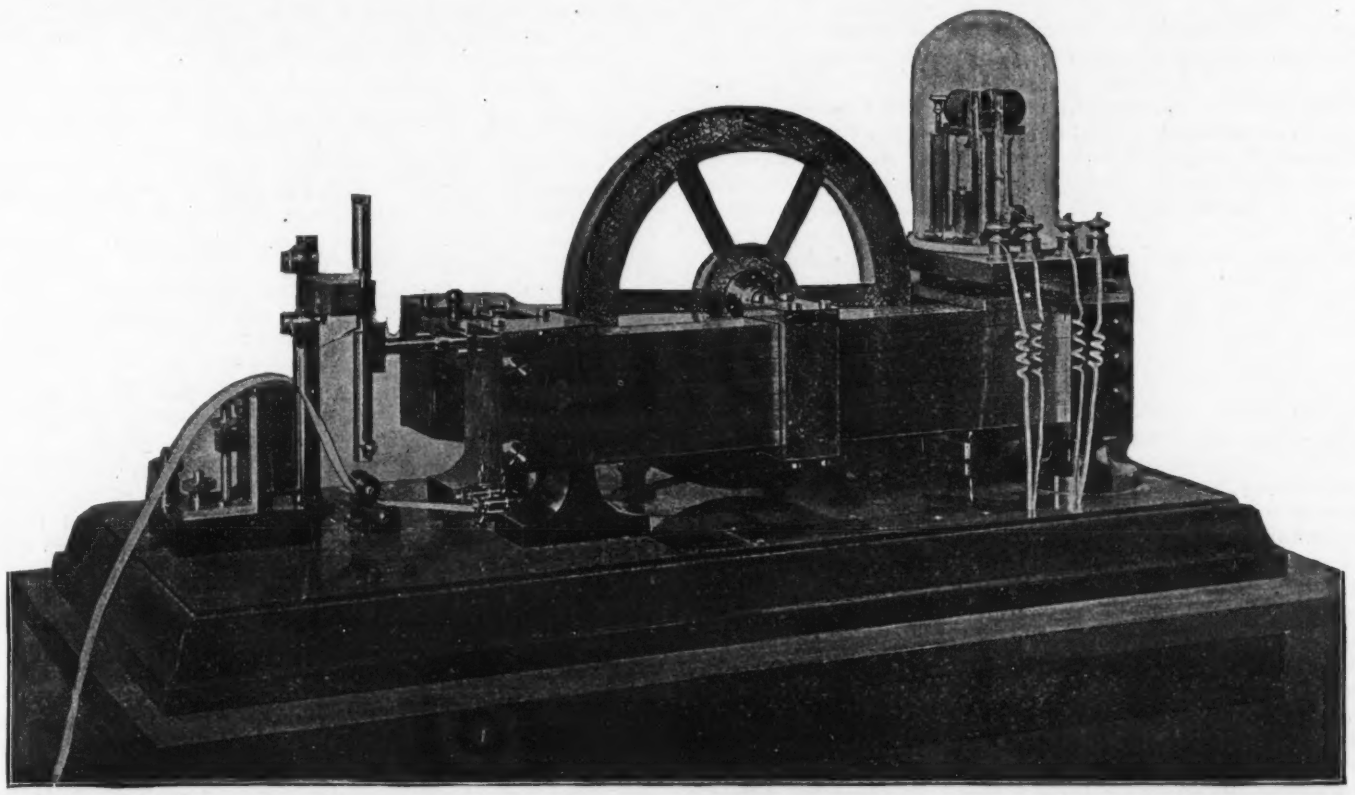
It is popularly supposed that cablegrams are received by means of flashes of light; but that system is all but abandoned; in fact, the Commercial Cable Company never employed it, but adopted the recording system invented by Sir William Thomson (now Lord Kelvin). The instrument was very complicated when the company received it, and much care and attention was necessary to keep it in good working condition. It was, to a great extent, dependent on the weather, being difficult to operate well on damp, muggy days.



CUTTRISS AUTOMATIC TRANSMITTER.

The improvements effected by the company's electricians have removed all its weak points, and it is now one of the most reliable of telegraph machines. Its principal parts are a light rectangular coil of silk-covered wire and a powerful magnet. The coil is suspended between the poles of the magnet, and when excited by the electric current from the cable it swings upon a vertical axis. Its movements are recorded on a paper ribbon drawn at a uniform speed before the point of a fine glass siphon no thicker than a human hair, which conducts a stream of ink from a reservoir to the paper ribbon. The marking end of the siphon responds to and multiplies every movement of the coil, and leaves on the ribbon an inky trail, which is an exact and permanent record of the movements of the coil under the influence of the currents from the cable.

In the improved recorder, as devised by Mr. Charles Cuttriss, the Commercial Cable Company's electrician, and shown in one of the illustrations, the siphon is vibrated by magnetism. The coil is pivoted on jewels, and its motion controlled by magnetism so applied

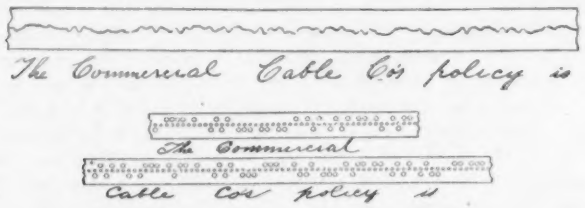


THE IMPROVED SIPHON RECORDER.

as to take the weight of the coil off the pivot and hold the coil almost suspended in the air, thereby securing the maximum freedom of motion and of control. This method of controlling recorder coils renders them so extremely delicate that a speed of 250 to 300 letters per minute is constantly maintained. The Cuttriss vibrator, for vibrating the siphon of the siphon recorder, is shown at the upper right hand of the illustration just referred to. The siphon must be kept in constant vibration to do away with friction between its point and the paper ribbon, as otherwise no reliable record of the movements of the recorder coil can be obtained, the current from the cable being too feeble to overcome even a small amount of friction.

Two forms of automatic senders are in use and are shown herewith. Automatic transmission has been in successful operation on land lines for many years, but was not considered valuable, or even practicable, on long submarine cables until Mr. T. J. Wilmot, the Commercial Cable Company's superintendent at Waterville, Ireland, produced a modified form of Wheatstone automatic transmitter, and demonstrated conclusively that it was swifter and more accurate than keys manipulated by the hands. The signals received from an automatic sender are uniform in shape and size, whereas those from the hand vary with the operator. The automatic sender, therefore, not only does more work in a given time, but, what is much more important, the uniformity of its signals enables the receiving operator to translate them with greater certainty. The liability of error is consequently minimized.

Motion is imparted to the transmitter by means of a weight, and the electrical contacts are controlled by a paper ribbon perforated with three rows of holes as shown. The upper and lower rows



Message as Sent and Received.

determine the polarity of the current sent into the cable. The middle row engages a toothed wheel by which the ribbon is drawn along.

The second form of automatic transmitter also shown is novel in form and construction. It is the invention of Mr. Charles Cuttriss, and possesses important advantages. An important feature is the intermittent motion imparted to the ribbon, by which it is possible to vary the duration of current and earth contacts in any proportion of one to the other.

Sparking at the transmitting points is absolutely prevented by a cam device, which never opens the contacts while a current is passing through. In other words the cam makes and breaks contact when the circuit is free from current and consequently the points work bright and clean. The clock work and weight of the older forms are abolished and continuous motion is obtained from a self-governing electric motor, also the design of Mr. Charles Cuttriss, which will run efficiently with six cells of battery, and not vary its speed if placed in an electric light circuit.

One of the most important of the many uses of the standard condenser is to measure the inductive capacity of a submarine cable. When a cable is charged with the current from a battery, static induction is set up between the conductor and the water through the guttta-percha insulator. A part of the charge is retained and acts as a clog on the speed of the signaling currents. The less the inductive capacity the greater will be the signaling speed and consequently the greater the commercial value of the cable. The condenser is an apparatus which affords a means of determiining by comparison the capacity of a cable. It is composed of a large number of alternate sheets of tinfoil and mica, the office of the mica being to separate the sheets.

An apparatus invented by Dr. Alex. Muirhead, of London, is used to accomplish on one wire the simultaneous transmission of messages in opposite directions and is known to electricians as "duplexing" the line. To do this efficiently, the electrical qualities of an ocean cable must be imitated is an artificial line. A continuous narrow strip of tinfoil represents the conductor in qualities of conductivity and resistance. Sheets of paper soaked in paraffine represent the gutta-percha insulation, and sheets of tinfoil represent the medium surrounding the cable. The artificial line is built iup in the following order, repeated as often as necessary: Paraffined paper; tinfoil strips; paraffined paper; tinfoil strips. The strip of tinfoil is continued backwards and forwards upon the surface of the paper, the lines being separated by a space of ⅛ of an inch. The mass is then placed in containing boxes, two feet square by six inches deep. Metallic connection is made at frequent intervals with binding posts on the outside of the boxes.

This motor was designed specially for the purpose of drawing the paper ribbon under the point of the siphon. A sensitive governor regulates its speed, and, consequently, that of the ribbon. The speed of the ribbon must be regular to preserve uniformity in the record made by the siphon, otherwise the record could not be translated with any certainty. The ribbon moves under the siphon at the rate of 30 inches per minute. The governor, when once set, will maintain any given rate within the half of one per cent. The motors are so wound as to run equally well on an electric light circuit, or a battery circuit of six or more gravity cells.

The Feeder and Main Patent.

The United States Circuit Court of Appeals for the Third Circuit rendered an opinion on Tuesday of last week reversing the opinion of Judge Green, of the United States Circuit Court for the District of New Jersey, which had sustained the feeder and main patent. Judges Acheson, Dallas and Butler were on the bench and the opinion was written by Judge Acheson.

The court defines the patent as dealing with the one particular difficulty of drop, to remedy which the patentee provides special conductors extending from the generator to the main conductors with which the lamps are connected, and from which they are served, and is for a specific arrangement and proportioning of these two sets of conductors, which together constitute the complete circuit. The claims are stated to be perfectly clear and definite, and are for a single circuit composed of a pair of transmitting conductors and a pair of distributing conductors having the specified characteristics without regard to any other like circuit, and the gist of the alleged invention is stated to lie in the combination and proportioning of these two parts of the circuit and not in their use.

The court criticises the action of the court below in incorporating into each of the claims, which are stated to be pefectly clear and definite, limitations other than those expressed and which should have been excluded. The Supreme Court is quoted to the effect that it is unjust to the public as well as an evasion of the law to construe a claim in a manner different from the plain import of its terms.

The primary question for solution as laid down by the court, is whether any invention is involved in a patentable sense in combining a circuit for feeding only with a consumption circuit, the main conductors of which are so proportioned as to maintain such uniformity of pressure upon them that there is practically no variation in the candle power of the lamps connected therewith. In the present instance the patent in suit is declared to disclose no new means either for transmission of current or for equalizing pressure upon the consumption circuit.

It is pointed out that the patent leaves it altogether to the judgment of the electrical engineer or contractor to determine the relative length of the two parts of the combined circuit and the proper thickness of the conductors. Thus it is left where, the court states, it properly belongs—to the intelligence of the electrical engineer—to select feeding conductors of large or small diameter depending upon the apparatus or cost of copper or power, or upon some special circumstances. The feeding conductors of the patent are in truth nothing more than the ordinary supply wire running from the source of electrical energy and, as a matter of course, there are "no translating devices connected therewith." The statement in the specification that the drop upon the feeding conductors has no effect upon the relative candle power of the lamps, which is only affected by the drop in the main conductors, is declared to be a mention of an obvious fact. It is a quality inhering in the circuit by the very nature of things and is a nceessary incident of any circuit, part of which supplies a current and part of which distributes it.

The knowledge how to secure uniformity of electrical pressure is assumed by the specification itself to be a matter of common knowledge, and, the court states it is, in fact, a matter of mere calculation, to aid which formulæ had been worked out prior to the date of the invention.

The court declares that in the art of electroplating as practiced long before 1880, an arrangement of circuits substantially the same as that of the patents in the suit was used, and that in Khotinsky's French patent of 1875 there was shown and described a circuit of

feeding and consumption parts identical in form with that of the patent in suit.

How can it be affirmed, it is asked, that it would require invention simply to proportion Khotinsky's circuit in the manner contemplated in the matter in suit—to make his trasmitting wires and transmitting conductors respectively of suitable size to perform their intended fuctions?

The court refuses assent to the suggestion that the alleged invention supplied a long felt want or met a difficultygenerally recognized in the art as a serious hindrance to the distribution of electric current. Prior to the application for this patent no incandescent light plant had been built, and there had been no occasion to erect such a plant, and electrical engineers had not been called upon to deal practically with the problem of drop in the construction of plants. In truth the feeder and main system of distribution came naturally in the progress of the art of incandescent electric lighting, as and when needed. A practical incandescent electric lamp had been invented and when the occasion for its use actually arose the feeder and main system were forthcoming. It is a great mistake to attribute to the patent in suit the merit of having solved the problem of economically supplying the electric current for extensive use to circuits covering large areas, portions of which are at great distances from the source of electrical energy. The economy of copper is confined altogether to the trasmitting conductors and the cost of copper restricts the use of this system to comparatively narrow limits. The extension of the incandescent electric light over large areas is really due to subsequent inventions, conspicuous among which is the alternating system.

The opinion sums up by stating that the multiple arc system of distribution being confessedly old, and the high resistance incandescent lamps being devised, to provide "feeding conductors to extend from the generator or generators, to the main conductors of the lamp of consumption current" was an obvious engineering expedient. Thereafter the proper proportioning of the two parts of the combined circuits involved only the exercise of the common knowledge and skill of the electrician. The plan of electrical distribution covered by the claims in question is not the creative work of that inventive faculty which it was the purpose of the Constitution and the patent laws to reward, and to sustain the patent would be to sanction a monopoly in that which belongs to the public.

Reference is made to the ruling of the Supreme Court in regard to the nullity of a patent for an invention that is described and claimed in a prior patent. The question raised in this case, which was in regard to an earlier patent of Mr. Edison's dated March 22, 1881, is declared to be a serious one, but the court considered it not necessary to take it up, as the views expressed upon the other branch of the case are decisive.

How to Make a Voltmeter and an Ammeter.—For Amateurs.

BY G. E. DUNTON.

These practical working instruments are so simple in construction that they come within range of any amateur's ability to make, and the writer of the following article will endeavor to make the description of the meters, as designed and constructed by him, so clear that any reader who may desire can construct instruments of his own that will do as good work. The construction of the two instruments, as far as the mechanical part goes, which will be taken up first, is identical, with the exception of one or two minor points which will be noted as we proceed; their real difference is in the respective windings and position in the circuit.

To commence with, purchase a piece of brass pipe 1½ inch internal diameter, and to give a finished length of 1 7-16 inch. Heat to a cherry red and plunge into water, to make sure that it is annealed properly. This must be flattened out carefully as shown in Fig. 1 section, the dotted circle denoting its original shape. Note carefully all measurements and dimensions given on the plans, as they will not be repeated in the descriptive text. On each end drill and tap six screw holes for 1-16 inch brass "Fillister head" machine screws, Fig. 1A section. Directly on the centre of side, drill a 5-16 inch hole completely through the brass, Fig. 1B, and ½ an inch each side of the centre of this hole drill through two smaller holes, tapping for 5-64 inch screws, Fig. 1C. The collars which go on the core, forming the wire spaces, are made from sheet brass, 1-16 inch thick. The two on the ends, shown in Fig. 1D section, and in Fig. 2, are drilled for the six screws with which they are fastened to the ends of the core. The two middle ones are made to slip on over the core, and are nicely soldered in place; Fig. 1E shows them in section, and the dotted lines in Fig. 2 show the size of the hole. There is a difference in these two washers on the ampere meter; instead of being plain, as in the voltmeter, there is a slight recess pressed into one side. This allows a space for the beginning end of the copper strips, used in winding, to be brought out from in under the coil. The dotted lines, Fig. 2B, show the shape and depth. This recess comes on the back side of the core, setting in toward the centre hole on the amperemeter only.

The hangers are made from 1-16 inch sheet brass, carefully annealed, cut out with a cold chisel and filed up to a nice finish. The front side hanger is longer, as shown in Fig. 3, than the rear side, as shown in Fig. 4, while the section is the same. The screw holes in the feet, A, are drilled to admit the screws with which they are fastened to the core. In the centre of each hanger, B, drill and tap holes for 3-32 inch screws, to be used for the adjustment of the movement of the instrument, and which should have a 1-32 inch hole drilled in to the centre of the threaded end to the depth of 1-16 of an inch, and also to be fitted with little check nuts, Fig. 5A and B.

The spindle on which the needles and pointer swing is made from the finest grade 3-32 inch steel wire, with both the ends sharpened down to a fine, smooth point, Fig. 6A. After cutting the wire off (a little longer than the finished length), square up with a file each end nicely to the exact length the finished spindle will be. The piece may be put in the lathe chuck, and at moderate speed pointed off nicely and smoothly with a fine file, finishing up with Scotch stone and water. The point should be ⅛ of an inch long. The little hubs or bosses for the needles and pointer are turned from round brass bar. The hub carrying the needles is drilled through its centre for the spindle, as shown in Fig. 7A. Fig. 6B shows it in place between the needles in section. The hub carrying the pointer is a little different, as shown in Fig. 7B and C, in plan and section. The hole for the spindle is drilled nearer to one side, and the shoulder on the back is turned on a radius with it. A hole drilled in this shoulder, as shown in Fig. 7D, is for a 1-16 inch set screw. The two needles shown in section Fig. 6C and Fig. 8 plan are made from the very best sheet spring steel, 1-32 inch thick, drilled through the centre, as shown in Fig. 8, and carefully swaged on to the brass hub, over the shoulders; or to be more correct, the brass bosses should be swaged out to hold the needles on, and the surplus brass filed off smooth. This, which is in reality the armature—in one sense mechanically, though not magnetically—should be put on the spindle temporarily, and accurately balanced so nicely that it will not come to rest twice in any one position. The balancing can *only be done* nicely on knife-edged ways. On the perfection of this part of the work depends the instrument's accuracy. Drill two holes through the hub into the spindle hole at right angles to each other (the armature of course being removed from the spindle), as shown in Fig. 7E and F, Fig. 1F and H; tap out for 1-16 inch screws. Carefully cut a thread on a piece of 1-16 inch brass rod a distance of ⅞ of an inch from the end; great care must be taken not to twist off the wire rod. Screw this into the hole on the under side of the hub and sweat it in with soft solder. Snip off the surplus wire remaining beyond the thread and smooth up the end, repairing the thread if jammed in cutting. This screw carries the thumb nut adjusting the balance weight, Fig. 1G. In making the accompanying drawings, the writer has tilted the needle shown in dotted outline, in Fig. 1, the wrong way. The middle of the end marked "N" should come just above the bottom of the upper coil-space, hanging nearly, though not quite, horizontal, and tilting just in the opposite direction from that shown in the plan, Fig. 1. This applies to both meters. The adjusting weight and thumb nut of brass are shown in Fig. 9.

The pointer should be made of aluminium if it is possible to obtain a strip of this metal in sheet; if not, brass may be used. Fig. 10 shows the pointer in plan and section. Work the point down as thin as possible and paint it (the end) black. Fit on over the boss on the front side of the brass pointer hub and fasten as the needles were. The whole may now be placed on the spindle and as nicely balanced as the armature was. The scales are cut from copper, on a radius of a 10-inch circle, forming an arc of 120 degrees. Brass will do, but do not use any metal that will magnetize. The stock should be 1-16 inch thick. Finish down the face smooth, drill ⅛ inch screw hole in each end, as shown in Fig. 11A. The face should be given four coats of white enamel and baked in steam heat. If the builder cannot readily procure the enamel, white paint will answer and will not require baking. The supporting studs and washers, shown in Fig. 12A, B, C, are turned from brass. The hole at D is tapped out for the 6-32 screws holding the scale in place. The washer B is drilled at three points, E, to take the little 3-32 inch brass wood screws. The post, A, is riveted into

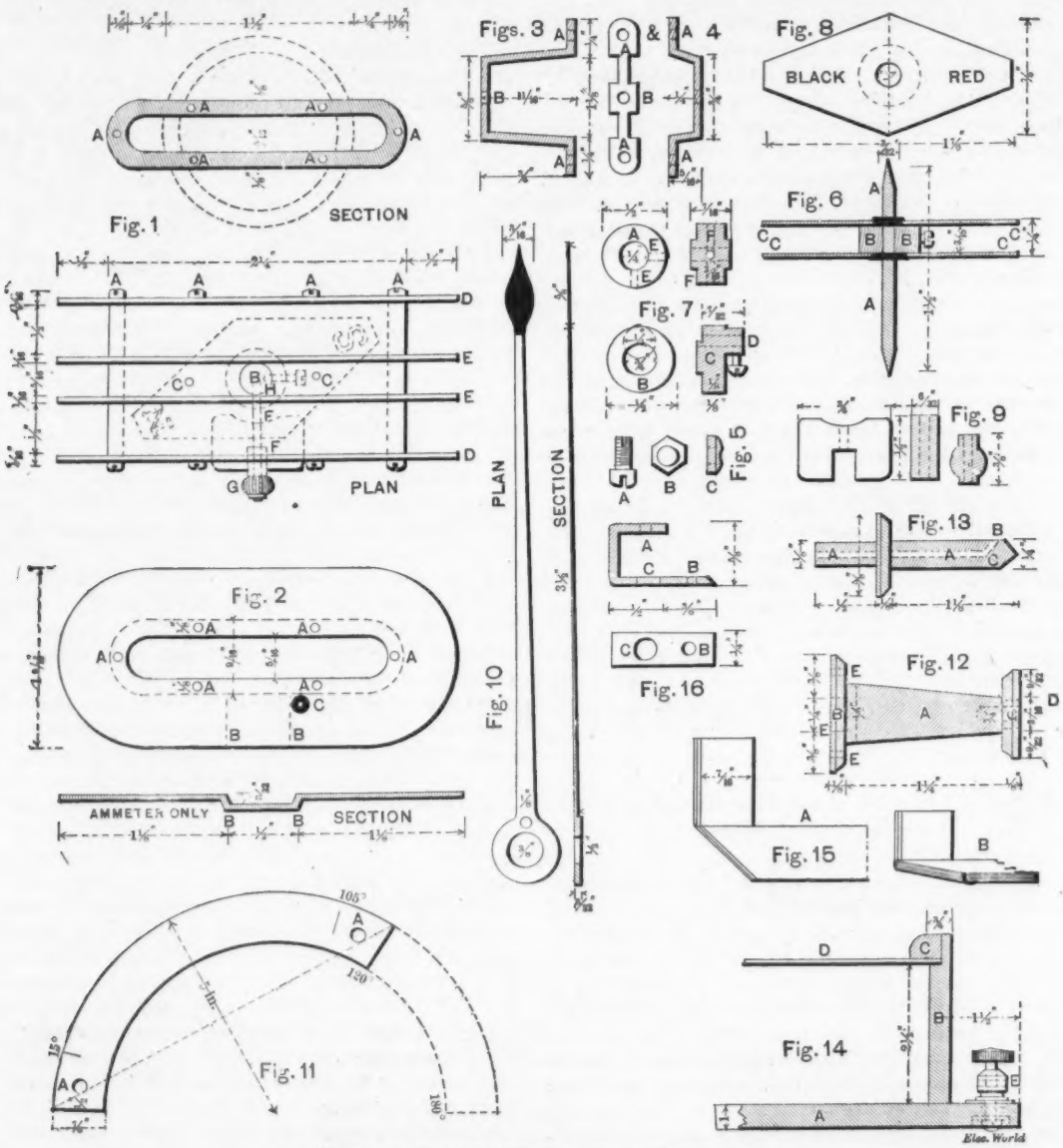
both washers. Two fibre posts, as shown in Fig. 13, are drilled up through their length, from the under side or end, but not going clear through the top end; let the hole, A, stop at the point, C, and here be intersected by the hole, B, drilled in through the side quite near the end. In case the two coils are connected in multiple, a second hole should also be drilled through the side, lower down, and half an inch above the washer, as at B. A thread is cut on the bottom end and a washer interposed between the hub on the post and the back of the case.

In making the boxes or cases, the writer believes that the builder should follow his own tastes as to design and finish. The cases on the models are made of mahogany, ¾ inch stock, the outside washed in a weak solution of potash to give the wood a darker hue, and the inside stained, or properly, dyed, to imitate ebony, by using several alternate applications of hot solutions (separate, of course) of logwood and copperas. This gives a beautiful rich, dead-black finish, a good imitation of unpolished ebony, making an excellent background to show up the works of the instruments. The frame front, or cover, is 8½ by 6½ inches inside measure, 2½ inches deep under the glass, with the under edge felted. It can be hooked on to the back, or hinged as the models are, and fastened with a lock to check the curious. The back should be made in alternate layers, with the grain of the wood running at right angles, and glued up; or, if in one piece, have the ends cleated and tongued and grooved on to prevent all possibility of warping. This should be fully 1 inch thick. Fig. 14 shows a section of the case: A is the back; B, the bottom side of frame; C, quarter round molding; D, glass; E, binding post, which can be purchased at any of the supply stores. The little feet which hold the whole mechanism to the wooden back are made of 1-16 inch brass, as shown in Fig. 16, and screwed to the core outside and next to the feet of the back side hanger; A shows the screw hole; C, drilled larger, admits the screwdriver to turn this screw, and B is for the wood screw.

The entire instrument should be put together before the wire is wound on, to see that all the parts fit and work as they should. Feeling fully satisfied with the work so far, the works should be all removed from the core, with the exception of the collars, and laid carefully away in some covered box. A hole will have to be drilled through the two middle washers, on the rear side, with a ⅛ inch drill plugged with fibre, finished off smooth with the brass collar, then a 1-32 inch hole drilled through the centre of the fibre, as shown in Fig. 2C, if the two coils are to be connected in series.

The windings of our instruments are extremely simple. Taking the voltmeter first, we must have sufficient wire on its core to a little more than equal the resistance of one of the incandescent lights in the circuit, or have a resistance coil of fine German silver wire in series with the wire in the magnet coil. The resistance of the model is about 24.9 ohms, which is not sufficient for from 50 to 60 volts, and a resistance coil must be put in. If the two meter coils are in series this resistance should equal about 90 feet of No. 30 German silver wire; if the coils are connected together in parallel, about 60 feet of No. 28 of the same will be sufficient. This wire should be coiled into open spirals and strung between slate supports outside of the meter case, as it will heat some. (See cut of the writer's instruments on page 17, The Electrical World, July 7. In this voltmeter the resistance is in 6 coils, 15 feet each, above the case protected by a wire netting cover.)

We shall need a quarter pound of No. 30 B. & S. gauge, commonly called 10 mil wire, the diameter being 10-1000 of an inch. We will not use quite all this wire, but it is safe to have a little more than what is actually required; single-covered (cotton) copper wire will do all right, if the beginner will use care in winding it on. Collars of the leather board should be fitted on over the core snug



Details of Volmeter and Ammeter.

and rest close up against the washers, with a thickness of asbestos paper wrapped around the core. The needles must swing around from the left over to the right, in order to carry the pointer over the scale in the right direction to read the E. M. F. of the current.

(To be continued.)

The Best Proportions of Armature Diameter and Length in Dynamos and Motors.

BY M. H. JOHNSON.

The bearing which the ratio of the diameter and length of the armature have upon the material used in the construction of a dynamo does not seem to have received the attention it deserves considering its importance in the designing of electrical machinery.

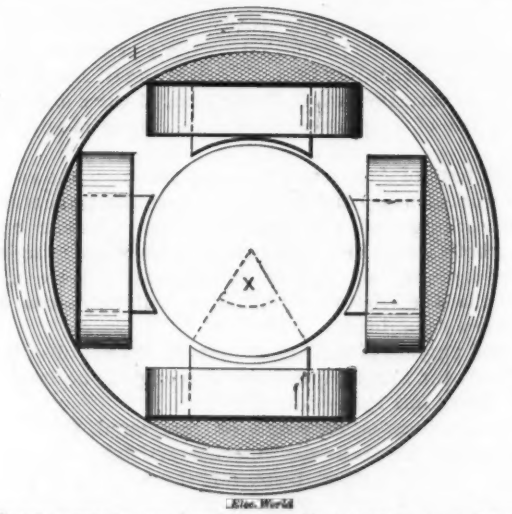
In order to determine the matter and reveal the best proportions for the armature, it is necessary to investigate the variables in the machine dependent upon its output and their relation to the dimensions of the armature.

In the types of machines usually met with there are four principal variables. They are the magnet core and yoke, the armature core, the field wire, and the armature wire. These quantities are not truly derived from the diameter and length of the armature, but are complicated functions dependent upon each other and constants for the material as used; but it is not the purpose of the writer to go into formulæ which are chiefly of use to students. So, for the sake of simplicity, it is assumed that the output of a dynamo is at all times represented as $W = D^2 S Ra$.

Where

D = diameter of armature;
S = spread of armature;
R = revolutions per unit of time;
a = constant depending upon units and material used.

To further simplify the matter let us consider a four-pole, shunt-wound machine having magnet cores without polar extensions and



BEST PROPORTIONS OF ARMATURE DIAMETER AND LENGTH.

pole pieces which span a fixed arc of the armature circumference = X, such a machine as is shown in the accompanying illustration. In dynamos of this type cross sections of the frames at right angles to the armature shafts of machines having different armature diameters are similar geometric figures whose areas are proportional to the square of their perimeters or diameters. So the material of this part of the magnetic circuit is proportional to D^2 times S, and economy in the use of iron is not to be effected by altering the ratio of D and S in a machine, for the intensity of induction, speed, etc., being the same, the weight of iron or steel varies as the output.

In a machine of this type, the number of conductors on the armature (or number of turns) is proportional to $\frac{\text{Volts}}{a\,R\,S\,D \sin \frac{X}{2}}$

and if the volts, speed and X are constant, the number of turns is proportional to $\frac{1}{S\,D}$. The length of one turn is proportional to $2S + b\,D$ (b is a constant depending upon the winding).

Now if D and S are altered in a machine of given output so that $D^2 S$ = constant, and the armature resistance be kept constant, the area of the conductor must increase as the length, and the weight as the square of the length. Hence these relations:

Length of conductor proportional to $(S + D)\frac{1}{D\,S} = \frac{1}{D} + \frac{1}{S}$

Area " " " " $(S + D\,\frac{1}{D\,S} = \frac{1}{D} + \frac{1}{S}$

Weight " " " " $\left(\frac{1}{D} + \frac{1}{S}\right)^2$

In a machine of this character, the area of the air gap is practically equal to that of the magnet core, and its length varies approximately in proportion to the diameter of the armature, as does also the metallic part of the magnetic circuit; therefore the ampere turns required to excite the field vary as the diameter of the armature. Assuming the resistance and current in the magnetic coil to be constant, the proportions of the coil are these:

Number of turns proportional to		D
Length of one turn	"	$D + S$
" " wire in coil	"	$D^2 + D\,S$
Area of conductor	"	$D^2 + D\,S$
Weight	"	$(D^2 + D\,S)^2$

From the foregoing we get an idea of the dependence of the weight of copper in a dynamo upon the armature dimensions. In the particular case here taken,

Weight of armature copper $f\left(\frac{1}{D} + \frac{1}{S}\right)^2$

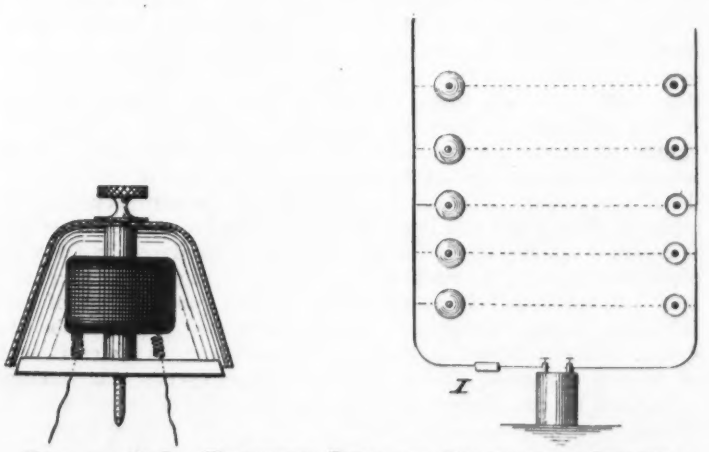
" " magnet " $f\left(D^2 + D\,S\right)^2$

It will be noticed that these are both functions which reach a minimum value at $\frac{S}{D} = 2$. So it is apparent that $\frac{S}{D} = 2$ is the best ratio to use in proportioning the armature for the style of machine upon which this determination is based. These values do not represent the relations in machines of all other types, but a little study will reveal them, and the proportions will be found correct, except in extreme cases.

Harmonic Call Bells.

BY S. D. MOTT.

I have frequently been asked if it is not possible to do away with the noisy clapper-stroke bell which grates so harshly on many ears, and why some one does not devise and introduce a better substitute for it than the buzzer, which makes the nervous ones in our homes jump when it signals by the suddeness of its noisy clatter, adding its quota to the general din of many modern appliances and conveniences. When loudness as a warning of danger or alarm, etc., is not a prime requisite it would certainly seem that an agreeable musical tone would be far preferable in homes, banks, and banking houses, hospitals and like institutions where quiet is desired.



FIGS. 1 AND 2.—HARMONIC BELL AND DIAGRAM OF CIRCUIT.

I believe to a majority of commercial users of call apparatus such a system would be appreciated and would be given preference.

Acting on the hint I herewith show sketches of a certainly simple, and inexpensive, and possibly useful, harmonic system of signalling.

The sound producer or resonator may be fashioned bell shape, this is, fastened to one extremity of an electro-magnet, to the other extremity or pole of which is fixed rigidly an armature. The bell is made of magnetic material and serves with the armature, also of magnetic material, to nearly close the magnetic circuit. (Fig. 1).

It is evident now to those acquainted with the general physical

principle of harmonics that if an alternated or interrupted current be used having the same rate of vibrating impulses as the musical pitch of the resonator, or an octave thereof, the bell will sound its note on the closing of the circuit through the magnet coil.

The system, though based upon a rather delicate principle of operation may, I think, be roughly made after being accurately planned like many familiar devices in commercial use.

Such calls may be made highly ornamental, easy to enstall, inexpensive and indestructable, having no clapper or moving parts.

Fig. 1, shows a complete bell, consisting of bell, in section, armature core, coil and fastening screw, the whole furnished in any fanciful or ornamental design.

Fig. 2, is a diagram of a call connection arranged in parallel circuit, and showing in the battery circuit an interrupter I, properly proportioned and adjusted to the requirements of the bell.

When one bell only is required, the push button may be constructed to act as the interrupter or alternator of the battery current.

If operated with a suitable magneto device, no buzzeror battery is required, but only the magneto and push button to each bell circuit would be necessary. If a magneto of sharp snappy impulse and changable period were used on a line of bells run in series and having varying tones, it would be in an operator's power to cause any particular bell to respond when the magneto current reached the note of the particular bell selected, by varying the speed of the magneto or otherwise causing a uniformity and equality of electric pulsation, with acoustic vibration; in a word, when the acting and responding device were in concord.

Rope Driving—XII.*

BY J. J. FLATHER.

It has been previously stated (see The Electrical World, Oct. 21, 1893), that where rope driving is used the loss at the engine in friction may be taken in a general way as about 10 per cent. of the rated horse power of the engine, that an additional 10 per cent. is absorbed by the shafting, and that from 5 to 8 per cent. may be attributed to losses in the rope itself, due to resistance to bending, wedging in the grooves, differential driving effect, and creep, all of which affect the loss to a greater or less extent.

According to the accepted laws of friction we should expect that with an increased load on the engine the friction would be increased in direct proportion to the load, but in nearly all experiments to determine the friction of steam engines we have the anomaly that the work necessary to overcome friction is practically constant, and, in fact, in many cases it is a little greater when running without load than when the engine is fully loaded.

Although it may appear paradoxical, it is probable that the ordinary laws of friction obtain here as in other cases of sliding and rolling contact, but instead of having a constant coefficient of friction for the surfaces in contact, the coefficient may be considered as a variable depending upon the degree and distribution of lubrication—with increased loads on the engine the relative position of the elements of the bearing surfaces is changed to a greater extent during each revolution than with lighter loads, owing to an increased momentary fluctuation, and thus it is that a better distribution of the lubricant is maintained; it is also probable that on both sliding and rotating pieces where the pressure or direction is reversed a pump-like action or suction is produced by the very slight distortion of the surfaces, in which case we should expect not only a better distribution, but also a greater consumption of the lubricant if this action is sufficiently intense. Whatever be the cause, it is safe to assume that as the load increases the coefficient of friction decreases, so that at all ordinary speeds the internal resistance of the engine may be considered sensibly constant, in which case the so-called friction card of the engine represents practically the friction of the machine when fully loaded—the indicated power without load being sensibly the measure of the wasted work of the engine when in operation under load of whatever amount.

That is, the engine friction is independent of the load and is a function of the characteristic of the engine itself, of the speed of piston and rotation, and, to a slight extent, of the steam pressure, and of the method of steam distribution, so that while we may speak of the friction as being a certain percentage of the horse-power of an engine, it must be understood to refer to the rated indicated horse-power: at less than rated power the percentage of loss due to friction will be greater and at maximum power the per centage will be less. This is shown by way of illustration in the following table, which is taken from a paper presented by Prof. Thurston before the American Society of Mechanical Engineers in 1886.*

TABLE XII.—FRICTION PER CENT. UNDER VARYING LOADS.

Revolutions per Minute.	Steam Pressure.	Indicator Horse Power.	Friction Horse Power.	Friction per cent.
232	50	7.41	3.35	45
229	65	7.58	2.60	34
230	63	10.00	4.00	40
230	73	11.75	3.65	32
230	75	14.02	4.02	28
230	80	15.17	3.17	21
230	75	16.86	2.86	17
230	75	28.31	3.36	11.75
229	60	33.04	3.16	9.5
229	58	37.20	2.34	6.3
229	70	43.04	3.19	7 4
230	85	47.79	2.75	5.8
230	90	52.60	2.60	4.9
230	85	57.54	2.54	4.4

This engine, a "Straight Line," was 8 inches in diameter of cylinder by 14 inches stroke, it had a balanced valve with stroke varying from 2 to 4 inches according to position of governor and eccentric, a fly wheel 50 inches in diameter weighing 2,300 pounds. Its rated load was 35 to 40 horse-power.

Examining the above table, it will be seen that the friction of the engine varies somewhat with varying steam pressures and total power, but in such a manner as to indicate the controlling cause, as, for instance, imperfect lubrication, to be irregular in action, and, possibly, to some extent, due to errors of observation and to accident. The average friction horse-power is 3.11-h. p., and the variations from this value are distributed throughout the whole series, showing that the work necessary to overcome the friction is practically constant and independent of the load. The friction of this engine is extremely low, as at its normal rating the percentage of loss is less than 7 per cent. According to D. K. Clark† the frictional resistance of steam engines varies from 8 to 20 per cent. of their normal indicator h. p.—the size of engines experimented upon ranging from 13 to 350-h. p.

In recent tests of American engines it has been shown that with first-class workmanship and balanced valves the percentage of loss at normal working load has been kept down in some engines to 6 per cent., both with Corliss and with high speed single cylinder automatic engines, but this is exceptional and we may expect ordinarily that the frictional resistance will vary from 8 to 13 per cent. of the normal load.

Compound engines of the better class should not absorb more than about 10 per cent., and triple expansion engines no more than 12½ per cent. under full load.

For small engines, either single or compound, there is probably little difference between the internal resistance, whether geared with ropes or flat leather belts, for the weights of fly-wheel and grooved pulley and the diameter of shaft would be essentially the same in each case. With larger engines, however, the belts would require a wider-faced fly-wheel, which, on account of the greater distance between bearings, would necessitate a larger shaft and hence increased journal friction. Assuming the same weight of wheels and speed of rotation with the rope driving, the speed of the rim will be greater and a somewhat lighter pulley may be used to insure the same degree of steadiness in running; moreover, the elasticity and recoil of the ropes act in the same manner as mass in the rim, and for this reason a lighter wheel may be used with rope driving provided the construction is such as will permit it; moreover, in many cases the ropes are delivered from the fly-wheel in a nearly vertical direction, so that a certain portion of the weight on the bearings is neutralized by the upward pull of the ropes. The journal friction is therefore presumably less in the larger class of engines employing ropes, when compared with those using belts; the difference is, however, not great, and since the actual resistance in any case is also dependent upon peculiarities of type and construction, the lower values of engine friction previously given, viz., 8 to 10 per cent. of normal horse-power, may be considered to hold good for rope driving plants of medium size, while 9 to 12 per cent. of the normal horse-power may be taken as suitable for the larger class of engines running under favorable conditions.

* For the last section of this article see The Electrical World of April 28, 1894.

† Thurston Trans. A. S. M. E., Vol. x, p. 110.

* Trans. Vol. VIII. p. 90.

† The Steam Engine, Vol. II, p. 616.

In the ordinary transmission of power by shafting we find the shaft loaded with pulleys and the power taken off in varying amounts throughout its entire length—it is unusual except in short lengths to receive the power at one end and transmit it at the other. Moreover, in long shafting the head or receiving shaft is usually situated midway between the ends and the power distributed more or less uniformly from this head shaft to either end; therefore, in estimating the power absorbed by friction in ordinary mill or factory shafting loaded with pulleys, the previous formulas do not apply, as these relate only to those cases where power is taken off at the end of the shaft.

The conditions of practice as we find them in actual transmissions are so various that it is difficult to lay down any general rule by which the power absorbed by friction may be determined—the number and weight of pulleys and couplings, the intensity and direction of belt pull, the condition of bearings and their lubrication, all affect the amount of work lost in friction.

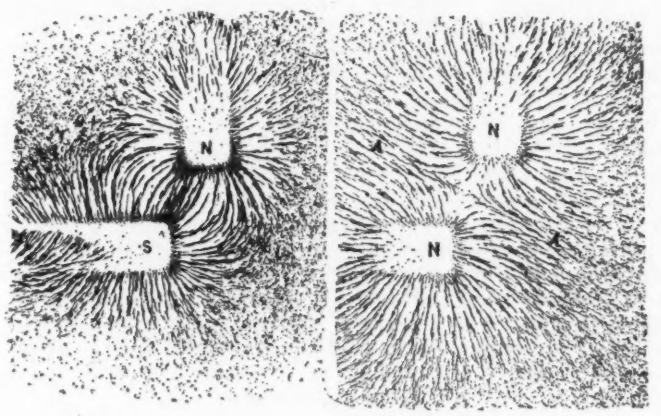
(To be continued.)

Dynamo-Electric Machinery—VIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Fig. 38 illustrates the flux distribution attending the approach of what are called unlike poles. Here the ether streams, we assume to issue from N, take the paths indicated in entering the magnet S.

Fig. 39 illustrates the flux distribution attending the approach of what are called like poles. Here the hypothetical ether streams

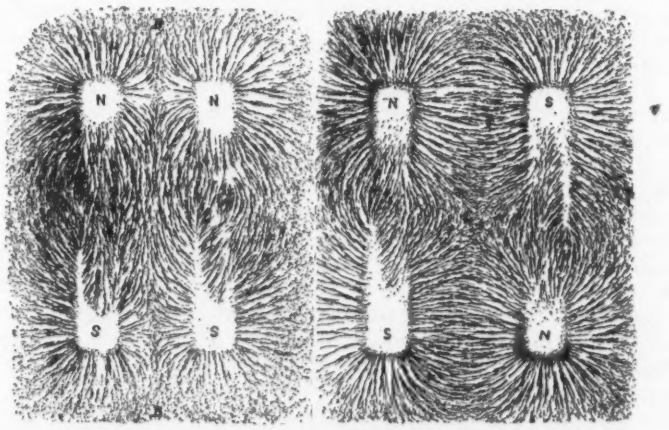


FIGS. 38 AND 39.

issuing from N, N, impinge, as shown, and produce a neutral line A A, corresponding to slack water in the hydraulic analogue.

Fig. 40 shows the distribution of flux in the case of two straight bar magnets laid side by side with like poles opposed. The imaginary ether streams again oppose and the neutral line B B, is produced as shown.

Fig. 41 shows the distribution of magnetic flux in the case of two straight bar magnets, laid side by side, with unlike poles opposed. Here, according to hypothesis, some of the ether streams issuing from each magnet, pass back through the other magnet, the



FIGS. 40 AND 41.

remainder closing their circuit in the air outside. A curious central region between the magnets, bounded by curves resembling hyperbolas is shown at C, where, by symmetry, no ether motion pene-

trates, and thus corresponding in the hydraulic analogue to calm water.

Fig. 42 shows the distribution of flux over the surface of what is commonly called an anomalous magnet, that is a magnet having two similar poles united at its centre; or, in other words, having two

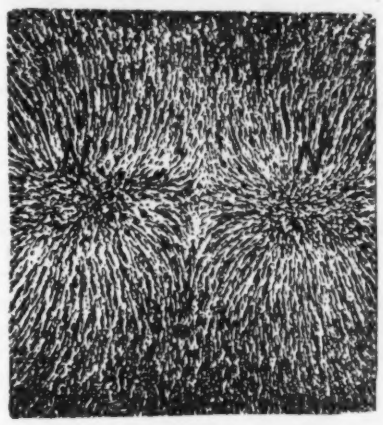


FIG. 42.

separate magnetic circuits. Here the distribution of flux is similar to that in Fig. 40, where like poles are approached.

40. Having given the M. M. F. in gilberts, the flux which will be produced by a magnetic circuit depends upon the disposition and nature of that circuit. For example, it is not to be supposed that the flux produced by the 12 ampere-turns (15.084 gilberts) in

FIG. 43.—RIGHT-HANDED HELIX OF 12 TURNS CARRYING ONE AMPERE.

the right-handed coil or helix of Fig. 45, by one ampere and twelve turns would be exactly the same either in magnitude or distribution as the flux from a single turn carrying 12 amperes, although the M. M. F. would be the same in each case. Just as in the case of an electric circuit, the current produced by a given E. M. F. depends on the resistance of the circuit, so in the case of the magnetic circuit, the magnetic flux produced by a given M. M. F. de-

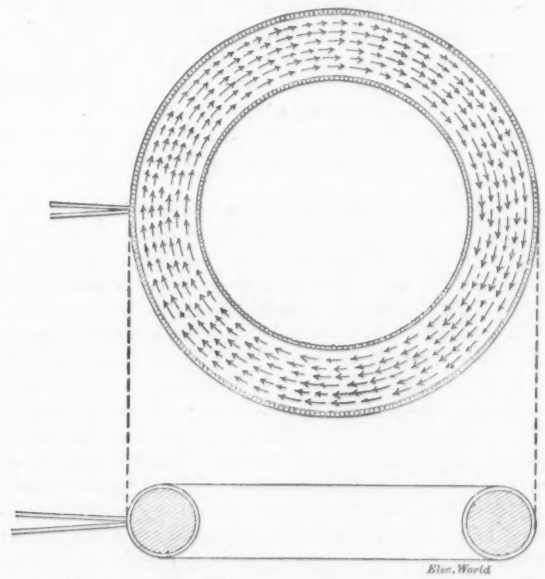


FIG. 44. — SECTIONS OF WOODEN RING UNIFORMLY WRAPPED WITH INSULATED WIRE CARRYING A CURRENT.

pends on a property of the circuit called the magnetic reluctance or simply its reluctance.

Magnetic reluctance, therefore, is a property corresponding to electric resistance, and is sometimes defined as the resistance of a circuit to magnetic flux.

41. The reluctance of a circuit is measured in units called oersteds. An oersted is equal to the reluctance of a cubic centimetre of air (or, strictly speaking, of air-pump vacuum) measured between opposed faces. Unlike electric resistance, the reluctance of

all materials, except the magnetic metals, is practically the same.

Having given the reluctance of a magnetic circuit and its total M. M. F., the flux in the circuit is determined in accordance with Ohm's law; that is $\Phi = \frac{\mathcal{F}}{\mathcal{R}}$ where Φ, is the flux in webers, $\mathcal{F}$ is the magneto-motive force in gilberts and $\mathcal{R}$ the reluctance in oersteds. It may be afford assistance to contrast the well-known expression—

$$\text{amperes} = \frac{\text{volts}}{\text{ohms}} \text{ with the corresponding magnetic expression}$$

$$\text{webers} = \frac{\text{gilberts}}{\text{oersteds.}}$$

42. The unit of magnetic flux is called the weber, and is equal to the flux which is produced by a M. M. F. of one gilbert acting through a reluctance of one oersted, corresponding in the above expression to the ampere, the unit of electric flux, which is that electric flux or current that is produced by an E. M. F. of one volt though a resistance of one ohm. For example, if an anchor ring of wood, such as is represented in Fig. 44, have a cross section of 10 sq. cms. and be uniformly wrapped with insulated wire, then when the current passes through the winding, the magnetic circuit will be entirely confined to the interior of the coil or solenoid, and no magnetic flux will be perceptible in the region outside it. This is the only known form of magnetic circuit in which the flux-paths can be confined to a given channel. These flux-paths are all circular, and possess the same intensity around each circle. If the mean circumference of the ring be 60 cms., the reluctance of the magnetic circuit will be approximately $\frac{60}{10} = 6$ oersteds, just as in the similar case of electric resistance. If the number of turns in the winding is 200, and the exciting current steadily maintained at four amperes, the M. M. F. in the magnetic circuit will be 800 ampere-turns, or 1005.6 gilberts. From this the total flux through the ring will be $\frac{1005.6}{6} = 167.6$ webers.

(To be continued).

The Earth as an Electrical Conductor.

BY JOHN HENRY HOLT.

That the earth could be used to conduct electric currents was discovered by Stemheil, at Munich, in 1837. While experimenting upon the Nüremburg-Fürthet Railway to ascertain whether or not the track could be used as one of the conductors of a telephone circuit, he noticed that the current would pass from one rail to the opposite one, traversing the intervening earth, which at once led him to believe that he had discovered a most excellent conductor, the resistance of which was practically nil. As he thought, so has been the common belief among scientists generally, until recently, when engineers especially interested in electric railway work have turned their attention to the subject, and have proven the fallacy of such a theory.

It is no more than natural to suppose that a body having such an immense cross section should offer little or no resistance to the current. But we must remember that we are not, as is the case with a copper wire, dealing with a homogeneous mass of good conducting material. Stratified, contorted and twisted; here a metallic vein, a good conductor; there one of slate or rock, sometimes in horizontal beds, sometimes forming vertical walls of highly insulating material, together with the many subterranean watercourses —all go to make the earth a very complex subject to deal with.

About two years ago it was undertaken, at the Alabama Polytechnic Institute, to transmit power from an Edison generator on the college campus to a motor situated some 3,000 feet distant, for the purpose of operating the cotton gin, threshing machine and other power machinery at the experiment station. In undertaking this work it was decided to use the earth as a return, in the belief that by such an arrangement the cost of copper would be reduced just one-half. The result was that not sufficient power could be gotten at the motor to operate the lightest machinery at all successfully. There was evidently an immense drop in the line, which at once proved the plan of using the earth as the return impracticable.

Believing the great drop to be due to the employment of the earth, the professor under whose supervision the work was done tested for the resistance of the same, using the Wheatstone bridge, with direct current. He found it to be exceedingly high. Having had the following problems submitted to me, I undertook an investigation of the same portion of earth: (1) To find the resistance of the earth between the two terminal stations; (a) with earth plates used as grounds; (b) when placing the earth plates in wells at terminal stations; (c) when using ground and well plates in parallel. (2) To find the resistance between one terminal station and the successive intermediate stations, thereby showing the relative conductivity of the different strata. (3) How the resistance is affected by the polarization of the earth and well plates. (4) Is the resistance altered when using alternating currents? If so, how and to what extent?

Ground connections were made, one near the power house on the college campus, which hereafter will be designated station (A), and another at the farm, shown on the left in the figure and designated (B). These stations are, by measurement, 3,000 feet apart. Connection with earth at each was made by using large earth plates. They consisted, one of copper and the other of tin; were seven by two feet, and to each was soldered a No. 0000 bare copper wire. Each plate was placed in a pit eight feet long, two feet broad and six feet deep, and around the plates was well packed iron filings and charcoal, in addition to which some pieces of scrap iron were thrown in before the pit was filled with earth. Besides the earth plates, and at a distance of about twenty feet to the right and left respectively of each, is a well, in which, at the time of the test, the water stood about four feet deep. In each well was placed a thin sheet iron plate, measuring two and a half by three and a half feet.

(To be continued).

Engineering Education and the State University.*

BY WM. S ALDRICH.

Engineering education is an education for a profession. As such its first requirement is a liberal education, given by the pursuit of those studies affording mental discipline while developing a love of learning for its own sake and capable of imparting an added grace in the exercise of future accomplishments. The professional education follows, and distinctively technical features are to be combined with practical work of an educational value. This will be found in selected exercises and activities from among those required in professional life, in office, field, shop and laboratory.

Will such engineering education thrive in a university atmosphere? University presidents and renowned engineering professors have advised against its introduction into the university curricula. In the United States, education for engineering as a profession has not only been recognized as entitled to, but has actually received and been correspondingly benefitted by, a university environment, quite as much as in the case of law and medicine.

Federal and state aid to higher education received early recognition in the educational history of the country, chiefly in providing for academic training. Technical education received its most encouraging aid from private benefactions till its national endowment by the Land Grant Bill of 1862. The "Colleges of Agriculture and the Mechanic Arts," established pursuant to the provisions of this Bill, mark the beginning of a new period and of a peculiarly American development of national aid for promoting scientific and industrial education. Agricultural education languished, however; instruction in the mechanic arts had not yet developed into a science; and its incorporation into such colleges was somewhat incomplete until endowed schools led the way; meanwhile, scientific, classical and military instruction carried the day. It will probably be admitted that this Bill stimulated private endowment fo technical schools quite as much as it directly benefitted engineering education.

The Morrill Bill, of August 30, 1890, recognized engineering education and made possible some form of its development in all of the Land Grant institutions. Aside from instruction in agriculture and the English language, the remaining branches specified in the Bill are: "the mechanic arts, and the various branches of mathematical, physical, natural and economic science, with special reference to their applications in the industries of life, and to the facilities for such instruction." It seemed destined to endow and maintain courses in the mechanic arts, to support engineering laboratories, while some portion of the Morrill Fund might be allotted for the maintenance of instruction in the newly-acquired branch of experimental engineering. It came at a time when most urgently needed to strengthen the old courses and assist in establishing new and rapidly growing engineering courses, such as in electrical engineering. There were only two ways to realize "the more complete endowment and support" guaranteed by this Bill to all of the original Land Grant institutions: (1) by increasing the salary account; (2) by providing additional facilities for instruction, such

*Abstract of a paper presented at the Brooklyn meeting of the Society for the Promotion of Engineering Education.

as apparatus, machinery, text and reference books, stock and material.

The salaries of certain Chairs, formerly paid out of State appropriations, have been found to be legitimately payable out of this Morrill Fund, by reason of the instruction provided for by the occupants of those Chairs. The educational institutions of such States do not receive "*more complete* endowment;"—it is the State treasury or some other institution which receives it. The appropriation is increased from Washington but decreased from the State Capitol to the extent of the salaries so paid. In the same year that this was done hundreds of thousands of dollars were appropriated by one and the same State for an Insane Asylum! Pounds of cure: ounces of prevention.

Distinctions of race or color, made by any State in the admission of students to its Land Grant institution will require that State, by the provisions of this Bill, to make "a just and equitable division of the funds to be received under this act between one college for white students and one institution for colored students." This means two faculties, double equipment and a separate establishment throughout. Such States need for developing engineering education all that this fund will provide, especially that parasitism in the matter of salaries has already developed in some of them.

Engineering education is much less promoted by the Land Grant Bill, of 1862, than by the Morrill Bill, of 1890, for two principal reasons: (1) the classical and military instruction, provided for by the former, are excluded by the latter; (2) instead of the unequal permanent national endowments of the former, there is an equa annual appropriation given to each State by the latter. The effect of this favorable difference has been already felt in many of the States, and it has stimulated many additional private endowments to technical schools.

The least that the State could do in accepting this federal aid was to meet the simple requirements of the law, to purchase, erect and maintain suitable buildings in which the instruction provided for by the General Government could be materialized. Besides this, however, the establishment of light, heat and power plants by some of the States in their institutions has rendered very material and needed aid. Formerly urged for business reasons, such as securing greater economy of installation, maintenance and supervision, it has become apparent that these power plants gather about them facilities for shop work and laboratory training in electrical, steam and hydraulic engineering. State pride and competition will enhance still further their great economic and educational value.

Agriculture and mechanic arts have been inseparably connected in the minds of statesmen, when planning and developing federal aid for such instruction. However, when it comes to the question of national endowments for the promotion of scientific research, statesmen are divided, as is shown by the act of 1887 appropriating $15,000 annually for the establishment and maintenance of agricultural "experiment stations," in all of the Land Grant institutions. The direct aid which these have rendered to scientific agriculture has scarcely been less than the indirect benefit to agricultural education. The rapid growth of experimental engineering within the last decade; its recognized value for the determination of engineering data; its incorporation into the professional courses for almost all American technical schools, bespeak a like consideration for engineering "experiment stations" or laboratories, in connection with all Land Grant institutions.

Such a State engineering laboratory would be of invaluable service in the promotion of engineering education in the institution with which it would be connected. Engineering practice throughout the State would be reciprocally benefitted. The duty of the State in protecting life and property from engineering casualities and negligence would receive attention commensurate with that now given by the agricultural "experiment station," to healthful foods, farm and dairy, sanitation and stock raising. The State's resources of materials for building and other constructive work, as well as fuels, prevention of waste and utilization of by-products, would receive careful investigation. It should be allowed the same immunities and granted the same privileges now enjoyed by the agricultural "experiment station" in properly charging for tests, researches, analysis and other scientific investigations. State aid should be given for the publication and interchange of bulletins, quarterly or oftener, adding as much to the value and permanency of the year's work in engineering as is now done in agriculture. Engineering literature, researches, data and precedents would thereby receive an amount of careful attention that it is almost impossible for individuals, corporations or manufacturing establishments to give. What has been accomplished already by private munificence in many of the above lines of engineering work in the shops and laboratories of a few of our leading technical schools, should be repeated, extended and made possible in all of the Land Grant institutions.

Engineering education receives more or less consideration in the following classes of institutions: (1) those dependent entirely upon State and federal aid; (2) those receiving private endowments in addition to State and federal aid; (3) those dependent entirely upon private endowments. For any particular branch of engineering in any one of these, the technical studies of the class-room will be found much the same, while the academic requirements differ widely. The kind and amount of practical work, in office, field, shop and laboratory, will vary greatly according to the nature and extent of the endowment. In no other kind of education will financial considerations enter to change so completely every condition and alter so entirely every product, as in engineering education.

The faculty organization for engineering education has three distinct stages in its evolution: (1) engineering teachers are members of one common faculty; (2) they are organized as an Engineering Faculty, similar to the Law and Medical Faculties which usually exist at this period of development; (3) the organization of the Engineering College within the university, with its Dean or Director, whose duties are related to this college as those of president to the university. The faculties of State institutions are much less stable than in endowed institutions. Aside from political causes, the reasons are obvious and well known. There are engineering ethics and equities in teaching as well as in the practice of the profession. The most efficient professional teaching can be done and the most highly developed product obtained by departmental organization of which that of the Engineering Faculty is the first step in the right direction. The Engineering College is a plan of organization falling into line with a form of university management which has been remarkably successful in other branches in European universities. In our State universities, engineering education admits of such an ultimate ideal, and some of them have already taken the lead.

The federation of all State Colleges and Universities into a National University, with its educational centre at Washington, would place such an institution in the very midst of the most favorable environment for the prosecution of that kind of educational work for which it came into existence. Senate Bill 3824 was thus reported upon by the Select Committee (March 3, 1893): "It provides for the establishment of a university of the highest type, resting upon the State universities and other institutions of collegiate rank as they rest upon the high schools and academies, a university whose facilities shall be open to all who are ,competent to use them; but whose degrees shall be conferred upon such only as have received a degree from some institution recognized by the university authorities; and whose several heads of departments are to have advisory and co-operative relations with the heads of Government Bureaus for the mutual advantage of the Government itself and the cause of universal science."

The "Sine Curve" Controversy.*

In our issue of July 6th, on page 258, we observed that a considerable number of manufacturers in America are advertising the possession of a "true sine curve" as a valuable feature of their alternators. We returned to the subject a fortnight later, and on July 20th, on page 319, made some further remarks on the subject. After these were in type, we found that our views received full confirmation from some experiments which are being conducted with special reference to the efficiency of transformers but which are not yet completed. The matter has now given rise to considerable controversy, but is being led off the original line into cases of power transmission by special types of machines. Last week we referred to some foolish remarks in an American electrical journal published in Chicago; but the matter assumed a more important shape when, on Friday morning, we received The Electrical World of New York, dated August 18th, and found therein letters from Prof. Houston and Mr. Kennelly, Dr. Louis Duncan, and from Mr. F. W. Dunbar, together with an editorial comment.

Our esteemed contemporary, The Electrical World, takes the matter very seriously.

"It is seldom that we find it necessary to disagree in toto with our esteemed London contemporary, the "Electrician"; but, notwithstanding the ability with which it has clung to its opinion as to the non-efficacy of the sine form of curves of alternating E. M. F., we have not been able to see anything but hopeless error in its views of this subject. In our issue of last week, and elsewhere in the present issue, several correspondents whose opinions have an authoritative value, confirm the views we have expressed and offer an accumulation of evidence, both theoretical and experimental, which should definitely settle the

* From the London Electrician, August 31 and September 7, 1894.

question. The very neat general mathematical demonstration of Mr. F. W. Dunbar complements the special deduction in Kennelly's Institute paper on impedance, while the other letters bring to bear an accumulation of evidence that takes away every vestige of ground for the opinion which they contest. From both the theoretical and the practical standpoint it can be considered as definitely established that the sine form of curves of alternating E. M. F. is the best, for the reasons that it involves less inductive drop and less iron losses in transformers, and is absolutely necessary in motor work to avoid deleterious reactions from the upper harmonics otherwise present. To these advantages may be added the further one recently referred to by us in commenting on some German experiment with alternating arcs, which is that for the practical working of such arcs the sine curve insures smoother operation of the mechanism and a minimum of noise."

Our readers may judge for themselves as to the advantages of sine curves for arc work from the German paper, of which we print the first half in our present issue. We refer to this paper elsewhere.

Our critics, in the majority of cases, have made two mistakes in regard to our statements as to the value of a sinusoidal electromotive force. Firstly, they have undertsood us to say that the sine curve is the *worst* possible for such a function; whereas all that we did say was that it is a waste of time and skill to try to get a sine curve, because the sine curve is by no means the *best* possible. Secondly they have failed to realize that our criticisms are of a perfectly general nature, relating to the inherent qualities of the various electromotive forces, and by no means referring to the performances of any one particular machine. It is true that we pinned our remarks upon some trials of alternate-current machinery by Dr. Duncan; but we merely did so in order to say that these trials by no means warranted the general conclusion that the sine function is the best. Reference to our note, on page 319, will show this to be the case. It is quite possible that a certain motor might have such idiosyncracies as would lead it to work better with a sine function than with an electromotive force of any other form; indeed, Dr. Duncan seems to have discovered such a motor. He says:

"As far as the matter in question is concerned, the statement of Mr. Scott, of the Westinghouse Company, made in the discussion of the paper referred to, is very much to the point. He instanced the case of a two-phase motor, which, when driven from a certain dynamo, heated badly and had a great deal more 'armature slip' than was expected. It was found on investigation that the curve of dynamo E. M. F., was irregular, and the third harmonic was prominent. Being supplied with the sine E.M. F. the same motor ran efficiently and satisfactorily. Nothing can be more direct than this evidence. Mr. Scott remarked that in such a motor the third harmonic tended to turn the armature in a direction opposite to the primary wave, the result being disastrous. Mr. Steinmetz, who champions the three-phase system, pointed out that the third harmonic would tend to revolve the armature of a three-phase motor in the proper direction. While this is true, the efficiency of this component would be small."

We shall refer to the third harmonic presently. As to the evidence, it is by no means direct; it only shows that one particular *non*-sine curve was worse than the sine curve, with one particular motor.

Our esteemed friends, Messrs. Houston and Kennelly, are at

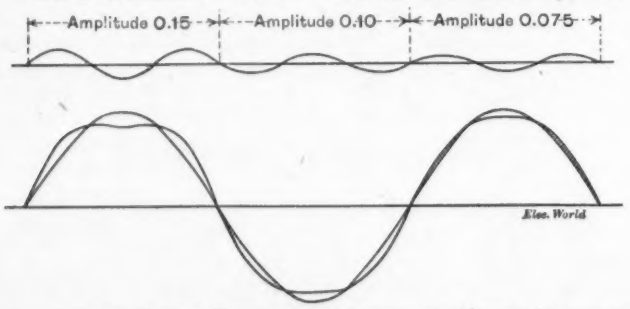


FIG. 1.—A SINE CURVE COMPOUNDED WITH ITS THIRD HARMONIC, WITH MAXIMA IN ANTI-PHASE: AMPLITUDE OF HARMONIC, 0.15, 0.1, AND 0.075, AMPLITUDE OF SINE CURVE BEING UNITY.

variance with us when we assert that this controversy is based upon the conclusions of mathematicians rather than of practical research. We quote from their letter:

"It is asserted that the reasons which have induced American designers to endeavor to obtain a sinusoidal E. M. F. in their alternators are mathematical rather than practical. This is by no means the characteristic of American electrical engineers, who are confessedly pre-eminently practical. In point of fact, the reasons, so far from being of a mathematical nature, are solely practical. It is known by observation that the loss of energy in the excitation of transformers is greater for non-sinusoidal than for sinusoidal E. M. F.'s, especially at high frequencies. It is true that the extra loss of energy through non-sinusoidal E. M. F. waves is usually not of sufficient importance to render a strictly sinusoidal E. M. F. of great value for merely lighting purposes. But for purposes of power transmission, deviations from the sinusoidal form of E. M. F. wave become deleterious, partly on account of the additional drop or pressure in the conductors transmitting the energy, partly owing to the additional loss of energy entailed in the transformers, but principally owing to the reactions set up in the induction motors by the virtual harmonics present in the sinusoidal form of E. M. F. whenever rotary field motors are employed."

Nevertheless, it is to the mathematics of Mr. Kennelly that Dr. Duncan and other adherents to the sine curve have referred us in support of their theories. Messrs. Houston and Kennelly make the mistake already referred to, of supposing that we are placing the sine curve at the bottom of the list.

It is vagueness itself to speak of comparisons between sinusoidal and non-sinusoidal curves, without naming exactly the components of which these latter are composed. There are non-sinusoidal curves which are vastly worse than the sine curve, and there are other non-sinusoidal curves which are decidedly better than the sine curve. Take, for example, Dr. Duncan's sine function with the third harmonic. If the harmonic is exactly in anti-phase with the fundamental, a condition of things shown in Fig. 1 will occur. The illustration shows that, with three different amplitudes, three different resultant curves are produced, every one of which has a less maximum than the primary curve. If the maxima of the two components are co-phased, however, the condition of things represented in Fig. 2 will take place. The resultant maximum will be greater than the maximum of the primary. For other phase relations between

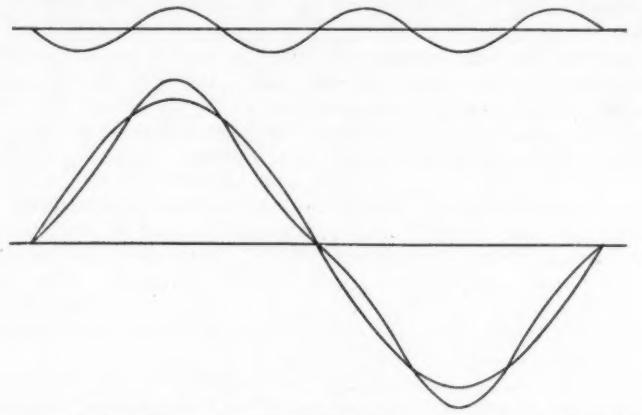


FIG. 2.—SINE CURVE COMPOUNDED WITH ITS THIRD HARMONIC WITH MAXIMA IN CO-PHASE: AMPLITUDE OF HARMONIC, 0.15.

the components, intermediate results would occur. Do our critics mean to say that the losses in an alternator, transformer, or motor would necessarily be greater with the flat-topped resultant curve in (Fig. 1), than with the fundamental sine curve? Do they insist that to get the best results it is necessary to avoid the flattened curve, as well as the peaky curve in (Fig. 2), and to get as closely as possible to the simple sine curve? We will grant them that the peaky curve will not best satisfy their wants; but we must insist that the efficiency of the flat curve is better than either of the others. In this connection we would refer our critics to the letter from Mr. Steinmetz,* which we published last week. Mr. Steinmetz says:

"The hysteretic loss per cycle in the transformer exclusively depends upon the limiting values of magnetism and will remain the same as long as these are the same. . . . If the wave of E. M. F. differs from sine shape, we can consider it as a fundamental sine wave with higher harmonics superimposed thereon, and then the wave of magnetism will also be a distorted wave, consisting of a fundamental sine wave superimposed by sine waves of triple, quintuple, etc., frequency. It is obvious now that if the triple harmonic wave of magnetism is superimposed upon the fundamental wave in such a way as not to increase its maximum value, the core loss will not be increased; but the amount of energy transformed is increased by the energy of the triple harmonic."

Finally, we would remark that since the flat-topped curve is the best for general distribution purposes, best for transformer and generator efficiency, and as good, at least, as any other for lighting purposes by glow lamps, and if we understand Herrn Rössler and Wedding aright, better than a sine curve or a peaked curve for arc lamps, it is therefore to the interest of makers to cultivate this type of curve. Herrn Rössler and Wedding, indeed, in the second part of their paper, for which we cannot find space this week, say, "Apparently it would be best to build machines whose curves approach the shape of Fig. 15."

This diagram, which we shall reproduce next week, is simply rectangular. That there are special cases where another type of curve is better adapted to the local conditions we are quite ready to believe: and we are also willing to recognize the existence of alternate-current plant which can only subsist on sine curves. But it remains yet to be shown that there is the smallest ground for believing the sine curve to be inherently the best and most efficient. This neither the able pen of Mr. Kennelly, nor the fallacies of Mr. F. W. Dunbar, nor the experiments of American electrical engineers, give any present indication of doing. While Dr. Louis Duncan goes to one extreme and considers the particular case of his peculiar and fastidious motor, Mr. Dunbar takes the other extreme, and so anxious is he to generalize, that he abandons the consideration of the

*See The Electrical World August 25, 1894.

presence of iron, and bases his arguments on a mechanical analogy. The discussion of the behavior of iron-less transformers and motors may be interesting to mathematicians, and of use to some kinds of students; but the whole point of *our* case is the effect on the iron. After recapitulating our remarks, Mr. Dunbar writes:

"These criticisms, coming from the London 'Electrician' and entirely unsupported by any theoretical or practical evidence, are even more astcunding when we consider the ease with which it may be shown that the most efficient rate at which electrical force may be applied to do useful work is the sine curve, and this without the necessity of discussing *individually* the 'intricate phenomena of alternating-current machinery.'"

He then indulges in some "iron-less" mathematics, and naturally arrives at the conclusion that where simple mechanical considerations of mechanics are concerned, a succession of simple sine impulses is the best. Having proved this he goes on to say:

"The sine curve of E. M. F., then, is the curve which will impart the greatest average momentum to an electrical circuit for a given average alternating force; that is, it is the 'best' curve for an alternating E. M. F. which is to be used to do useful work, for it is evident that all losses due to eddy currents, hysteresis, &c., &c., will then also be a minimum."

This conclusion is, we maintain, quite unwarranted.

Confidently as we maintain that a sine curve is not the best, and that a flat-topped curve is better, we must point out that the difference when reduced to £ s. d. is but a trifling amount. The experiments to which we have alluded agree well with those of Mr. Steinmetz, viz., that the iron losses in generator and transformer were about 10 per cent. greater with a sine curve than with a flat-topped curve. This flat-topped curve was not, so far as we are aware, designedly of that shape, and when the "best" curve has been obtained the difference will no doubt be greater. This week Mr. Steinmetz strengthens his former statements and our position by giving an example of a motor, in which the relative economy with the non-sinusoidal wave was as high as 13 per cent. His letter will be found in our correspondence columns. We do not, therefore, urge that the saving will be a large one. The matter is not one of vital importance; it is hardly worth having a demonstration in Hyde Park about it; but our original contention, that it is folly to struggle after a sine curve for general work, remains unshaken.

There was some ambiguity in part of our article on "The Sine-Curve Controversy" last week. We contend, with Mr. Steinmetz, that the flat-topped curve of magnetism is better than the sine curve. This means a peaked curve of volts. Our American friends, on whose side Prof. H. J. Ryan places himself, prefer the sine curve, When they speak of a sine curve of volts they assume, of course, a sine curve of magnetism also.

The Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—The discussion to which a recent editorial in the London "Electrician" has given rise, and which has been taken up with so much spirit by American engineers, is very interesting from the varied ideas which it has brought forth; as to the conclusions, I cannot see that they should be as absolute, whether in one sense or in another, as has been maintained.

The most prominent advantage of the sine form of curves of E. M. F. is that it permits results to be predicted with more precision than is possible otherwise. It is with an analogous end that recently the principle of articulations in stone bridges has been established, of which the calculation was formerly entirely problematical. In replacing the old form of alternator by an alternator with a sinusoidal form of E. M. F. calculations are, thereby given a real basis instead of an approached hypothetical one. Mr. Steinmetz states that calculations can be made upon the basis of an equivalent sine curve. Unfortunately this varies with the composition of the exterior circuit, and has, therefore, no practical bearing. There is no single sine curve always equivalent to the E. M. F. of an alternator when the latter is complex. The sine form of E. M. F. alone permits to be realized with success all the combinations involving reactance. The presence of higher harmonics may modify everything, not only in circuits where condensers are employed but also in others containing inductance apparatus, such as electromagnets. An arc lamp will not maintain its regulation when the form of the E. M. F. of its circuit is changed, and if we could always count on the sine form the regulation would be much more certain.

The danger from industrial currents increases with the presence of upper harmonics through the physiological effects being more grave on the one hand and on the other because the effects of capacity are more important and can no longer be compensated for exactly by inductances.

The harmonics reduce the efficiency of synchronous motors (at least if these do not present an E. M. F. of exactly the same form as that of the line, as Prof. Ryan has pointed out). Suppose a motor with an E. M. F. of the form E sin ωt is connected with a circuit whose P. D. is of the form

$$E_1 \sin(\omega\tau-\vartheta_1)+E_2 \sin(2\omega\tau-\vartheta_2)+E_3 \sin(3\omega\tau-\vartheta_3)+\ldots;$$

the first harmonic will alone give useful work, for the terms of the form

$$\int_0^T \sin\omega\tau + \sin(\eta\,\omega\,\tau-\vartheta)$$

are nul and, in addition, the upper harmonics absorb a considerable energy,

$$R\left[\frac{E_2^2}{R^2\times(2\omega L)^2}+\frac{E_3^2}{R^2\times(3\omega L)^2}+\cdots\right],$$

R and L being the resistance and self-inductance, respectively, of the motor. This effect is very sensible in practice. I have seen, for example, a synchronous iron-core motor with a sine E. M. F. (système Labow) which, running unloaded, absorbed a current varying from normal to double according to whether the E. M. F. of the alternator employed had or had not the sine form.

Moreover, the upper harmonics have necessarily the effect of reducing the efficiency of all induction apparatus, transformers or motors, through augmenting the foucault currents. This effect is practically negligible in transformers, but it can become important in closed circuit motors. In the latter, indeed, there are produced as many rotary fields with increasing velocity as there are harmonics, the efficiency of the apparatus only being good for a speed in the neighborhood of synchronism. All the rotary fields of higher order are almost useless and the heating is augmented in both the primary and the secondary. Finally, well made alternators with sine E. M. F.'s are exempt from noise and humming.

Such are the advantages of the sine curve, but they should not be exaggerated. In the first place, the increase of efficiency to which it gives rise is in general quite small; it seems to me impossible to believe that a motor of 40 h. p. could become as inefficient as Mr. Kelly has stated on account of a departure from a sine E. M. F. The three-phased high tension generators of Oerlikon and of Brown-Boverie, which give good efficiencies, are very far from giving sine curve E. M. Fs., and these two firms have had an experience in three-phased currents dating well ahead of American companies. Besides, the question of efficiency is not always preponderant, as seems to be often thought; in many cases the desiderata to be sought are cheapness, mechanical solidity, and a constant voltage. (Alternators that easily couple are those having a characteristic but slightly inclined, which is the secret of coupling).

In the second place, but little advance is often made by the mere fact of having obtained a sine curve E. M. F., for many ulterior causes may modify the current and even the P. D. at the binding posts. Without speaking of hysteresis, I have tried an alternator without iron of which the curve of E. M. F. was a perfect sinusoid on open circuit but one greatly deformed with a closed circuit. Inversely, alternators with iron may give a sine current at full load even though their E. M. F. is not sinusoidal. I have published, for example, curves of this nature in La Lumiere Electrique, August 18, 1893. This follows from the harmonics being, so to speak, eaten by foucault currents and smothered by self-induction. It is, however, quite a nother thing when transformers are employed, for the form of the primary, E. M. F. is far from being reproduced in the secondary.

Moreover, the employment of sine currents in induction motors is only a visionary condition if the coils are not disposed in such a manner as to obtain a sensibly constant magneto-motive force, for otherwise there are produced harmonics which only disappear at the cost of considerable foucault currents in the armature.

Conclusion: The employment of a sine E. M. F. can never be injurious; it is always to be recommended with a view to precision and is often indispensable; in certain cases it assures an important superiority of efficiency; in others this superiority is practically negligible. Under very frequent circumstances, in particular where transformers are employed, the realization of a sine E. M. F. is absolutely visionary, ulterior causes deforming the secondary in such a manner as to render most often entirely useless the efforts made to obtain the sine form in the generating machine.

Finally, it is necessary to know how to distinguish in what cases it is advantageous to endeavor to realize the sine form of E. M. F., and it is absurd to ridicule those who advocate its use under these conditions; the sine form should not, however, be held up as a panacea to which a superstitious respect should be paid. Here, as elsewhere, "in medio stat veritas."

A. BLONDEL.

Paris, France.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

The Voltaic Chain.—It is accepted as a law by many writers that the difference of potential between a metal and a solution depends on two constants: a constant for the metal and the cathion concentration of the solution; to test the validity of this Mr. Goodwin made experiments which are described in the "Zeit. feur Phys. Chem.," vol. 13, page 577, and abstracted in the Lond. "Elec. Rev.," Aug. 31; he concludes that the law which these experiments were designed to test is valid.

Alternate Current Resonance.—A paper by Mr. Wilson is published in the Lond. "Elec.," Aug. 31; it constitutes an experimental verification of one or two familiar problems in the theory of alternating currents.

Discharges Through an Orange.—According to an illustrated article in "La Nature," July 24, if a large battery of Leyden jars is discharged through an orange in the direction of its natural axis the whole orange will be illuminated, resembling an incandescent mass; if the discharge is passed perpendicularly to this axis the spark will pass around the outside of the orange and not through it.

Electro-optics.—A brief paper by Dr. Kerr, on a fundamental question in electro-optics, is published in the "Phil. Mag." for July.

Dielectric Constants and Chemical Equilibrium.—The paper by Mr. Nernst from the "Zeit. feur Phys. Chem.," vol. 13, p. 531 is abstracted in the Lond. "Elec. Eng." and "Elec. Rev.," Aug. 31.

Hydraulic Analogies.—An illustrated paper showing how the action of electric currents may be demonstrated by water currents, is published in the "Elek. Echo," Sept. 1.

Starting an Arc.—A translation of the article mentioned in the Digest, Sept. 1, is published in part in the Lond. "Elec. Rev.," Aug. 31.

Electrical Repulsion of Solutions.—The Lond. "Elec. Rev.," Aug. 31, contains a note on this subject.

MAGNETISM.

Molecular Theory of Magnetism.—A British Association paper on Hysteresis in a Rotating Magnetic Field, by Mr. Baily, is abstracted briefly in the Lond. "Elec.," Aug. 31. It is a deduction from Prof. Ewing's molecular theory of magnetism that in a rotating magnetic field the hysteresis should diminish at a high induction; the experiment described in the paper substantiates this deduction in a very complete manner. The paper is the subject of a long editorial, in which it is said to be a verification by experiment of a result which had been predicted as the consequence of the molecular theory; it thus furnishes the most convincing support that the theory could possibly have received; if the theory is correct it would lead to the conclusion that a piece of iron or steel revolving like the armature of a dynamo in a very strong magnetic field, should show no hysteresis and consequently require no expenditure of work to maintain its rotation; the experiment showed this to be the case.

Magnetic Shielding.—A Physical Society paper by Prof. Rücker, read almost a year ago, is summarised in the Lond. "Elec. Rev.," Aug. 31; he desires to find the best arrangement that can be made under specific conditions as to the allowable space and the weight of the shielding material; he also defines the relation between the shielding exerted by a number of concentric shields.

Magnetic Rotary Dispersion.—A paper by Mr. Moreau from the "Ann. de Chemie et Physique" for February, is mentioned in the Lond. "Elec.," Aug. 31.

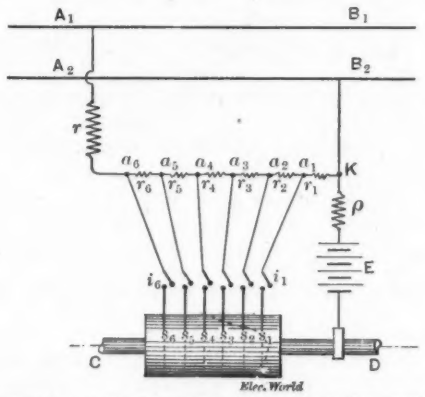
UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—The "Elek. Zeit.," Aug. 30, publishes a full description of the new unit of light and the apparatus for determining the same, which is hereafter to be used as the standard at the Imperial Institute at Berlin. The paper appears to be the same as that of which an abstract was given in the Digest, June 2, and of which an able discussion by Mr. Guilleaume was abstracted in the Digest, June 9 and 16. It was found that with the Violle standard results differing by 10 per cent. were obtained even when the greatest precautions were taken; neither the fusing point nor the point of solidification of the platinum gave a sufficiently definite temperature; the present method differs from the former in that a fixed temperature is obtained by means of a bolometer. The apparatus is fully described as is also the method of making the test; it is claimed that the reproduction of this unit is comparatively simple and that the errors are within 1 per cent. (Those interested in this unit should not fail to read the criticism of Mr. Guillaume referred to). The unit can be readily adapted to sources of different colors by adopting a different ratio in the temperature determination.

Photometric Units and Quantities.—In summarising the suggestions of Prof. Blondel, which were fully abstracted in the Digest, Aug. 11 and 25, the "Elek. Zeit.," Aug. 30, gives the following German terms for the various quantities: Lichtintensitaet for luminous intensity; lichstrom for luminous flux, beleuchtung for illumination, glanz for intrinsic brightness, belichtung for the quantity of illumination; (Fr. illumination); lichtmenge for quantity of light. The article strongly urges the adoption of the Hefner amylacetate lamp in preference to the Violle standard, on account of its great simplicity and of its sufficient accuracy.

Standards.—The English journals of Aug. 31, publish the official documents regarding the formal adoption by the English Government of the ohm, ampere and volt; it includes specifications for the use of the silver voltameter and the preparation of the Clark cell.

Method of Recording Current Curves.—An Academy paper by Prof. Blondel, on an electro-chemical method, is published in "L'Ind. Elec.," Aug. 25. The principal is shown in the adjoining cut, which



METHOD OF RECORDING CURRENT CURVES.

will explain itself; the recording drum which moves under the stiles must be driven synchronously with the alternator, either by means of a direct coupling or a synchronous motor; the resistances in the circuit to be tested, which in this case is the one connected to the two mains, must of course be non-inductive; formulas for the values of these resistances are given in the article.

Galvanometers.—Commenting on this paper of Prof. Schuster (see Digest, Sept. 8) the Lond. "Elec.," Aug. 31, points out that the basis of the formula is the magnetic force at the centre of the coil, but this, as Profs. Ayrton and Perry pointed out, gives erroneous results when applied to the case of a needle of sensible length; the error due to this would probably be large in Prof. Schuster's deductions; in such cases no calculations can be considered final if the want of the uniformity of the field is neglected; belief is expressed that the time is far distant when the sensitiveness given by Prof. Schuster will be approached.

Sensitiveness of Galvanometers.—In an article by Mr. Armagnat in "L'Ind. Elec.," Aug. 25, he discusses and compares the various ways in which the sensitiveness or the constants of galvanometers are expressed; he proposes to call a coefficient of sensitiveness of a mirror galvanometer the deflection produced by a current of one micro-ampere, the scale being placed at a distance from the mirror equal to 1,000 scale divisions, the duration of oscillation of the movable part being one second without damping.

Electro-dynamometers Used as Wattmeters.—"L'Elec.," Aug. 25, contains an article by Mr. Meylan which is supplemental to the one abstracted in the Digest, March 10 and 31. Since the publication of that first article he finds that there is a slight error in one of the formulas and in the present article he gives the deduction of the correct formula; the error, however, changes nothing in the general conclusions arrived at in his first article regarding the measurement of the watts in a circuit in which there is a lag.

Harmonic Analyzer.—Papers by Prof. Henric, Mr. Sharp and Prof. Perry are published in the "'Phil. Mag." for July.

DYNAMOS AND MOTORS.

New Kapp Alternator.—London "Electricity," Aug. 31, publishes an illustrated description taken from the London "Engineer."

TRANSFORMERS.

Transformer Systems.—An article in the Lond. "Elec. Rev.," Aug. 31, suggests that the numerous new automatic systems of switches for switching out transformers lose their value if the extra expense incurred is greater than the saving of the copper in the high tension lines.

ARC AND INCANDESCENT LIGHTS.

Spectroscopic Comparison of Different Lights.—In a paper by Mr. Muetzel in the "Elek. Zeit.," Aug. 30, he gives the results of some spectroscopic researches for determining the relative proportions of the different colors in the Auer (Welsbach) incandescent gas lamp, as compared with the incandescent and arc lights and the light from the sun. The comparison is based on lights which have the same intensity in the yellow part of the spectrum; the particular colors in question were reduced to the sam intensity by a Nicol's prism. The results, which are given in tables and in an interesting set of curves, are briefly as follows: The incandescent light has much more red than the Auer light, while in the latter the green is much more prominent; where warm colors are desired the incandescent light is therefore to be preferred; the arc light as compared with the Auer is poor in red rays but rich in blue and violet and it is also richer in green rays, but the latter is rich in red and orange rays and much poorer in the blue and violet; the Auer is therefore warm in comparison with the arc; in comparison with daylight the Auer light is yellow. The results, especially the curves, show that the arc light and sunlight are very similar, the former exceeding the latter both at the red end and at the extreme violet end, but is inferior to it in the rest of the spectrum; the arc light will therefore appear yellow when compared with sunlight.

Interior Illumination.—A paper by Mr. Nerz on interior illumination with arc lamps is published in the "Elek. Zeit.," Aug. 30. For small arcs he describes a method in which a small translucent glass screen, in the form of the frustum of a cone, encircles the carbon points where the arc is formed, appearing like a large incandescent mass; this is applicable only to small arc lamps; for large interiors he suggests throwing the light on the ceiling by using an inverted arc, the ceiling being painted a light color; he states, however, that this causes an unsteady burning of the arc because the crater of the positive carbon, which in this case is the lower one, acts as a receptacle for the ashes which, as they fall from the negative into the crater, cause an unsteadiness in the burning of the lamp until the ashes have been volatilized; he therefore concludes that the carbons as now made are not yet sufficiently pure to enable the inverted arc lamp to be used. He describes and illustrates a system in which the lower half of what corresponds to the globe is a reflector and the upper half a diffuser, the positive crater being as usual the upper one, a system which has met with great success in certain cases where diffusion was very necessary; in a table the areas are given which are illuminated by these lamps under various conditions. For very high ceiling rooms this system is not advantageous; as the light in that case is high above the eyes the direct system is preferable.

Lighting of Workshops.—"L' Eec.," Aug. 25, publishes an abstract of a paper by Mr. Dobson, in which he shows the advantages of the inverted arc lamp for the lighting of a cotton mill. The article appears to be the same as the one which was abstracted in the Digest, Nov. 18 and 25, 1893.

Incandescent Lamp of the Future.—In an article in "L'Ind. Elec.," Aug. 25, Mr. Claude discusses the possible directions in which the incandescent lamp may develop and concludes that it will probably be in the substitution of a refractive chemical compound for the carbon, such for instance, as the silicide of carbon; also in the use of a material which has two or three times the specific resistance of carbon.

Alternate Current Curves.—The paper from the German by Messrs. Roessler and Wedding on "The Potential and Current Curves of Different Types of Alternators and Their Influence on the Candle-power of Alternate Current Arcs," is published in a slightly condensed form in the Lond. "Elec.," Aug. 31 and Sept. 7. The paper was abstracted in the Digest, July 7, under "Current Curves for Alternators" and "Alternating Current Arc Lamps."

TRANSMISSION OF POWER.

Transmitting Power to Ships.—A device for connecting a moveable vessel with the shore by a cable capable of transmitting 200-h. p. is described and well illustrated in the Lond. "Elec. Rev.," Aug. 31; the cable is connected to a well insulated moveable joint at the anchorage of the vessel, from where connection is made with the vessel; the intention was to use it with a wave motor, but it can be used also for lighting lightships electrically from a generating plant on shore.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Accumulators Used with Motors.—The conclusion of the article by Mr. Darrieus, abstracted in the Digest last week, is published in "L'Elec.," Aug. 25. He gives the results of a number of discharges made with five cells in series and five like cells in parallel, all having been charged alike in series; a mean of six discharges shows that when connected in parallel there is a loss of energy of 13 per cent. as compared with the discharge in series; those that were connected in parallel were then connected in series and those connected in series were connected in parallel, after which a mean of eight discharges showed a difference of 23 per cent. (The compiler suggests that this difference is probably due to different rates of discharge of the individual cells in which case the difference in the discharges signifies a lower average capacity and not necessarily a complete loss of the energy unless the cells were charged in series with the other group, in which case they were simply overcharged). In practice he thinks this difference would be considerably greater; he cites a case in which accumulators were charged in parallel and it was found that one took 50 amperes while another took only 26; he concludes from this that accumulators should only be used in a single series. To run a motor at different speeds from accumulators the field should be separately connected with the batteries, in series with an adustable resistance; if still greater variations of speed are required, as for instance in railway work in which two motors are used, the two armatures may be connected in series or in multiple; when only one motor is used he suggests providing it with a double wound armature with two independent commutators and connecting these two windings in series or in multiple. A translation of almost the entire article, with the illustrations, is pubished in part in the Lond. "Elec. Eng,," Aug 31.

Series Incandescent Lighting.—The Goldston system is described and illustrated in the Lond. "Elec. Eng.," Aug. 31; besides the lamp base there is an additional support which presses against the lamp at the nipple in such a way that when the lamp breaks the support moves upward, thereby closing a contact which shunts the lamp; if the carbon is ruptured an arc will be formed which will break the bulb, which in turn will operate the shunt; the construction is exceedingly simple and the lamp is said to have worked satisfactorily.

Alternating vs. Direct Currents.—In commenting on a recent statement by Prof. Thompson that alternating currents cause less trouble from leaks than a continuous current of the same voltage, the Lond. "Elec. Rev.," Aug. 31, calls attention to the fact that with alternating currents the pressure to which the cable is subjected is not the effective but the maximum voltage, and it is the latter which should be taken into account in comparing alternating and direct currents of the same effective voltage.

Lightning in Central Stations.—The Lond. "Elec. Eng.," Aug. 31, records a case in which a central station was struck, the lightning passing from the building to the line and machines, and it concludes that it is very important that the station itself should be protected as well as the lines.

India.—An accumulator station at Bombay is described in the Lond. "Elec. Rev.," Aug 31.

WIRES, WIRING AND CONDUITS.

Electric Conductors for Coal Mines.—The Lond. Elec. Eng.," Aug. 31, describes briefly some safety cables for use in mines where there is firedamp. It appears to be taken from the same article which was abstracted in the Digest, Apr. 14.

Fuses.—Some regulations regarding the construction of fuses, as used in Hanover, are given in the "Elek. Zeit.," Aug. 30.

ELECTRO-CHEMISTRY.

Hermite High Tension Electrolyzers.—A device is described and illustrated in the Lond. "Elec. Rev.," Aug. 31, for electrolyzing small quantities of seawater for flushing and disinfecting purposes in private plants; it consists of 7 or 14 cells connected in series in one apparatus and is designed so that the ordinary lighting current of 100 volts can be used; a current of 15 amperes is required; 0.8 grs. per ampere-hour are obtained in each cell; with the larger one, one hour's working will produce 80 gallons of the solution at 0.5 grs. of chloride per litre; the cost of these 80 gals. is given at 25 cts. at the rate of 16 cts. per kilowatt-hour; to this the trifling cost of the salts must be added when seawater is not available; for a private house the cost will be merely trifling; it is recommended for hospitals and public buildings and espcially for steamers fitted with electric light.

Purification of Sugar.—The Lond. "Elec.," Aug. 31, abstracts briefly from a recent article by Mr. Bersch, in which he shows that the results are very satisfactory. The sugar juice is heated t 55° C, and is subjected for 10 minutes to a current of from 50 to 60 amperes at 6 volts, the anodes consisting of 7 zinc plates of a total surface of 64.5 sq. ft.; a grey green gelatinous substance is deposited at the cathode. By this means a better quality of refined juice is obtained in less time and with greater facility than formerly. The first cost of the plant at Hoym, in Germany, was paid for in a week by the superior economy of the process. Some additional data is given in the Lond. "Elec. Eng."

Amalgamating Zincs.—Mr. Oppermann, in the "Electrochem. Zeit.," for August, recommends very highly the following receipt: A nearly saturated solution is made of neutral sulphate of mercury in water with the addition of as much sulphuric acid as is necessary for the complete solution of the salt; to use it mix as much of this solution as is required, with as much of a solution of oxalic acid as is necessary to make a thin grey creamy mass; to this a little salamoniac is added and the zincs are then painted repeatedly with the mixture, after which the zincs are rubbed briskly and if necessary the process is repeated; it can be used even with very old rough zincs. Zincs thus amalgamated, besides having a very fine appearance, resist the action of acids and salts much better than those amalgamated in the usual way; they may afterwards be washed repeatedly with water; if they are not used at once they should be rubbed dry.

Storage Batteries.—In an article by Mr. Joel in the Lond. "Elec. Eng.," Aug. 31, he gives a list of English patents granted for accumulators, from 1866 to 1885 and some references to publications from 1831 to 1879; he shows that many inventions have already been patented many times over. The list is preceded by a description of the chemistry of accumulators by Gladstone & Tribe. He states that the most effective strength of the acid for economy of conversion of plate is about 1 to 10, equivalent to a specific gravity of about 1.150. According to Monnier & Guiton's estimate it takes 565,600 coulombs to peroxidize one kilogram (2.205 lbs.) of minium; according to Orava & Garbe each coulomb stored will set free 1.0289 milligrams of acid.

Purification of Zinc.—The Choate process is briefly described in the Lond. "Elec. Rev., Aug. 31; after certain metallurgical treatments in the fire the zinc plates are immersed in a solution of sulphate of zinc containing a little soluble chloride; on passing a current the pure zinc is deposited while the impurities settle in the bottom of the vat, where they may be recovered if desired.

Purification of Water.—Mr. Oppermann's article is concluded in the "Elek Echo," Aug. 25.

Soda.—According to the Lond. "Elec. Eng.," Aug. 24, an Austrian company proposes to erect works at Golling near Salzburg, for the electrolytic preparation of soda, etc., by the Kellner process; at this place the raw material can be procured cheaply, it being in a salt mining district and there is an available water-power of 2,500 h. p.

Practical Electrolysis of Chlorides.—A short article summarising the practical accomplishments in this direction, is published in the "Elek. Anz.," Aug. 23. The serial of Mr. Andreoli is continued in "La Lum. Elec.," Aug. 11.

Electro-Deposition of Cadmium.—A short article on this subject is published in the Lond. "Elec. Rev.," Aug. 24.

MISCELLANEOUS.

Treatment in Case of Accidents.—An article by Dr. Hedley, from the "Lancet," is reprinted in the Lond. "Elec. Rev." and "Elec. Eng.," Aug. 31. He states that if the elevation of temperature produced by the current exceeds 45° (if this is centigrade it is equivalent to about 113° F) death ensues by the coagulation of the muscular fibres of the heart, in which case recovery is not possible; but in most accidents the contact is generally of too short duration for producing this fatal elevation of temperature; d'Arsonval showed that this increase of temperature is not due to the heat generated directly by the current, but to the violent contractions throughout the whole muscular system, and also to the condition of asphyxia. For resuscitation he recommends the Laborde method, which is as follows: "With the thumb and index finger, either bare or covered by a handkerchief, the tongue is seized by its anterior third, and powerful repeated rhythmical tractions and relaxations are carried out with a frequency of about 15 to 20 times a minute. In making these tractions it is important to feel that the dragging action affects the root of the tongue. If, in attempting to seize the tongue, it is found that the jaws are closed and the teeth are clenched, open them with the fingers, if possible, or use as a wedge a piece of wood or the handle of a pocket-knife, or anything of the kind that may be at hand." He recommends that further experiments ought to be made in order to find out how the industrial currents injure or kill.

Accidents from High Tension Currents.—A translation of Mr. Claude's article abstracted in the Digest, Aug. 4, is published in abstract in the Lond. "Elec. Rev.," Aug. 24. "La Lum. Elec.," Aug. 11, notes seven recent fatal accidents, all of which were caused by alternating currents.

Ageing Brandy Electrically.—The Lond. "Elec. Eng.," Aug. 24, states that the annual report of the Brandy Distillers' Company shows that great progress has been made in the ageing of brandy by electricity, enabling them to dispose of their brandy at advantageous prices within 18 months after distillation; "the process consists of the application of ozonized compressed air to this spirit while it is under the influence of an electric current."

In a communication to the Lond. "Elec. Eng.," Aug. 31, Mr. Andreoli states that 18 months is extremely slow and shows that the apparatus is very imperfect; with a medium-sized apparatus a cask of wine can be ozonized within 4 to 6 hours, which should be followed with a rest of 3 months; the expense of this ageing is trifling and as the process is rapid it represents great economy.

New Book.

PERSONAL RECOLLECTIONS OF WERNER VON SIEMENS. New York: Macmillan & Co. 416 pages and portrait. Price, $5.00.

The "Personal Recollections of Werner von Siemens" is not only a review of the life of the author, but also a review of early electrical days, and therefore has a double value to electricians.

The style of the book is a vigorous one, and the reader will find its pages of more than usual interest, whether as the record of a useful and somewhat eventful life or for its contributions to the history of electrical development.

The father of Werner von Siemens was fortunate, or judicious, in the selection of a tutor, who first awakened in his pupil "the unextinguishable feeling of delight in useful work," though not every one would have profited by it as did young Siemens. He very soon showed a leaning towards mathematics and a distaste for the classics, which was fortunate for the public which has so largely profited by this preference.

In 1833, at the age of seventeen, young Siemens entered the army, and the years from 1835 to 1838 were spent at the Berlin Artillery and Engineering School, where one of the teachers was the mathematician, Ohm.

There he further developed his preference for mathematics, to which were added physics and chemistry. He says that "the fondness for these three sciences has remained all through my life, and has been at the bottom of my after successes." In 1840 he commenced experiments with the view of precipitating metals by means of the galvanic current. At this time he was involved as a second in a duel and was imprisoned, and to this confinement we probably owe the early discovery of the process of electro-plating. His first successful experiment was dipping a German-silver teaspoon in a beaker filled with a solution of hypophosphite of gold, connected with the zinc pole of a Daniell cell, the copper pole being connected to a louis d'or, serving as anode. The result was a satisfactory golden spoon. This process he sold for $160.

After his imprisonment he discovered a differential governor and then started the first establishment in Germany for gilding and plating. In this, and in many future projects, he was ably assisted by his brother William, who visited England and sold a patent for £1,500, and was so pleased with the prospects in that country that he decided to settle there.

After interesting himself with hot air engines he turned his attention to measuring the velocity of projectiles, paving the way to the invention of the chronograph. He next took up telegraphy, which occupied his attention on and off during the rest of his career. In the course of this work he intrusted the construction of some devices to a young mechanician named Halske, who completely gained his confidence. In 1846-7, after successfully purifying gun cotton with sulphuric and nitric acid, he first used gutta-percha as an insulator, and meeting with considerable success in telegraphy, he decided to devote all his time to it, and in partnership with Halske started a small workshop for the manufacture of telegraphic apparatus. The rising of the people in Schleswig-Holstein against the Danes furnished him another opportunity to distinguish himself. He planted submarine mines, electrically connected to observation points on shore, and the knowledge of this fact kept the Danish fleet out of the harbor of Kiel. This invention, though undoubtedly his, was by many ascribed to Prof. Jacobi in St. Petersburg. After the war he took charge, during the winter of 1849, of the construction of a telegraph from Berlin to Frankfort-on-the-Main, the first long distance telegraph line at work in Europe. In June of 1849 he had requested his military discharge and soon afterwards also resigned his office as technical manager of the Prussian state telegraphs. The firm of Siemens & Halske was now firmly established and they shortly obtained a contract for the construction of a telegraph from Warsaw to the Prussian frontier. In 1853 Charles Siemens, who had charge of their Russian business, successfully completed the Kronstadt submarine cable. Shortly after this Werner assisted Newall & Co. to lay their first deep sea cable from Sardinia to Algeria, and although he was not engaged as the engineer of the undertaking, his plans and methods of laying were adopted and the final success is largely if not entirely due to him.

In 1857, after working intermittently for seven years, he elaborated his device for employing intermittent currents for quick correspondence on long cable lines. This consisted, briefly, of a polarized relay, so constructed that when the armature was moved by a short impulse to the contact it remained attached to this until a current in the opposite direction carried it back to the insulated stop. In the electrical supervision (undertaken by the firm of Newall & Co.) of the cable from Suez to Kurrachee, in India, 2,500 miles in length, he first used the end of the cable as earth connection, which was practically the first employment of the condenser in submarine telegraphy, without which the Atlantic cable would have been impossible. His firm undertook and carried out a great deal of cable laying for England and France, and finally met with losses which brought about a crisis in its affairs. Meyer and Halske, two of the partners, wished to give up the London house, but were opposed by the brothers, Werner and William, which resulted in the establishment of the London business as "Siemens Brothers."

During the years from 1850 to 1856 he was also busy with Halske in improving telegraphic apparatus and measuring instruments, of which only a few were patented, though many proved the basis of future contrivances. He also devised apparatus to ring bells over a whole railway line upon the departure of a train, and as magnetic-induction was found indispensable, he first used the now well-known Siemens armature. His "plate" machine, constructed in 1855 for getting continuous currents of high tension, was in reality the precursor of the modern dynamo and

transformer. He also wrote and showed the practicability of duplex telegraphy by means of electro-magnetic apparatus, and then, turning his attention to the electrical units, he first suggested and used a column of mercury as a standard resistance, which was afterwards adopted by the Vienna International Telegraph Congress.

In conceiving the bold plan of a telegraph line from England to India the necessary capital to carry out this project was raised in London and Berlin without the aid of bankers. This exemplifies the high standing of the firm.

As early as 1866 the question occupied his mind whether it would not be possible, by the suitable employment of the so-called extra current, to considerably intensify the induction current. This led him to the discovery and first application of the dynamo-electric principle. His claim for priority of this has been impugned and credit given in England to Prof. Wheatstone, but his first complete theoretical establishment of the principle in the printed Transactions of the Berlin Academy and its previous practical elucidation have been decisive in his favor.

His great influence and ability in other lines is well shown in his successful reform of the Patent laws. After hard work between 1860 and 1870 a patent tribunal was established which marked the first step. Through his endeavors, in 1876, the last great step was taken. A meeting of manufacturers and administration officials was called together from all over Germany, which made the draft of the Patent Protection Union the basis of their deliberations. The bill resulting was adopted by the Reichstag.

In 1868 the large undertakings and growing business of the firm had caused the voluntary retirement of Halske, who felt he could no longer oversee the large dealings of so great a firm in detail. The author devotes much space to a tribute to this valuable friend and co-worker. After his retirement and Meyer's death, which occurred shortly before, the three Siemens brothers assumed the entire management and remodeled the business, forming a joint establishment embracing all branches. In England they established their own gutta-percha factory, thereby enabling them to undertake cable laying on a large scale and breaking the great cable ring monopoly. William von Siemens designed a vessel, named the "Faraday," for the purpose.

The firm being entrusted with the work of laying the cable from Ireland to the United States, Charles von Siemens took charge of the "Faraday." By his wonderful pluck and perseverance they were enabled to pick up and repair the parted cable at a depth of 1,800 feet. The successful laying of this transatlantic cable raised the London firm to the highest pinnacle of success, and in 1881 Mr. Gould ordered by cable a double cable to America similar to the French cable recently laid by the firm—the so-called Ponyer-Quertier cable. The credit of the firm was so good that Gould declined to receive a representative to complete the contract, but remitted a large installment at once.

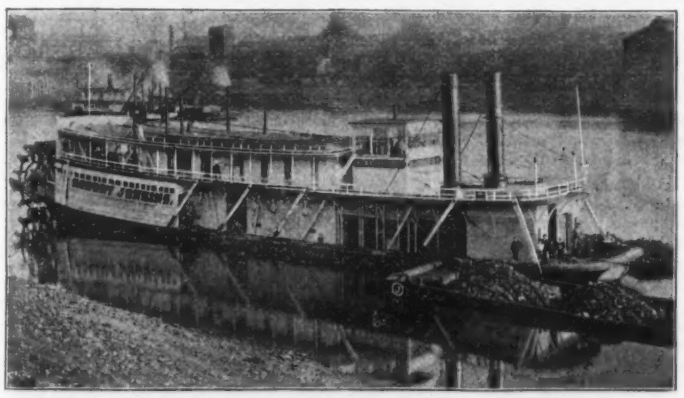
In 1882 the firm suffered a great loss in the death of William, who must have been a most extraordinary man, and to whose untiring energy and magnificent talents the success of the London house was almost entirely due.

At this time Werner was elected a member of the Berlin Academy of Science and his life after this was much taken up with scientific research and the publishing of scientific papers. Among other papers he published, in 1879, "Electricity in the Service of Life," and in 1886 "The Age of Science."

From this brief outline the remarkable character of this great pioneer in the electrical field may be surmised. The work is one of intense professional interest to the electrician, while the general reader will find it a most agreeably written account of a nature rich in the human qualities that command respect.

Electric Lighting on Coal Boats.

The lighting by electricity of the tow-boats, as they are used in the Pittsburg coal trade between that city and the port of New Orleans, is



AN ELECTRICALLY ILLUMINATED COAL BOAT.

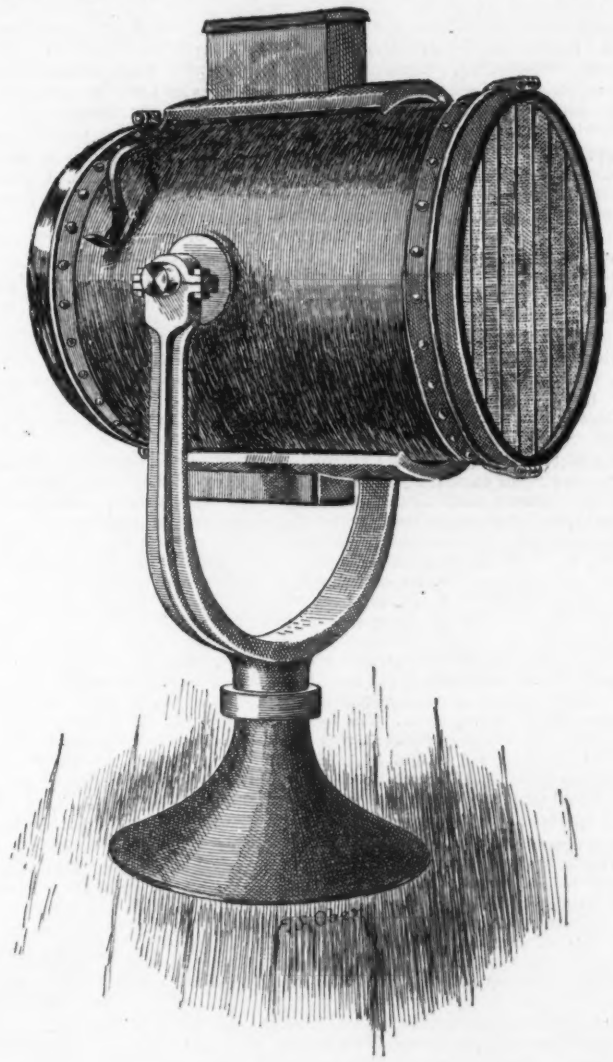
now becoming the method generally adopted for the illumination of these steamers, and its introduction has proved very satisfactory to the owners as well as to the crews of these boats.

The accompanying illustration is the picture of the steamer "Robert Jenkins," owned by the T. M. Jenkins Coal Company, and this boat is a very good representation of the general style of these steamers, of which there are operated about 100 between Pittsburg and New Orleans. They go up the Monongahela river for their cargo, which is loaded into barges at the different mines. The average capacity of the barges is 25,000 bushels of coal and one of the steamers will tow as many as sixteen and eighteen barges. The coal is taken down the Ohio and Mississippi, and is sold at the wharves of Cincinnati, Louisville, St. Louis and all points down as far as New Orleans.

The electric lighting plants on these steamers usually consists of a one-hundred light generator direct connected to a steam engine, so as to take up little space, and the generator furnishes current for the lighting of the boats as well as the search light. The plant on the Robert Jenkins was installed by the Westinghouse Electric and Manufacturing Company.

A New Searchlight.

The accompanying illustration shows the improved search lamp manufactured by Mr. S. W. Rushmore at his factory in Jersey City, N. J. The lamp shown is one of a complete line that he is building for all



A NEW SEARCH LIGHT.

classes of service, and is the type used mostly for river and inland navigation and as a buoy finder at sea. This type of lamp is made in sizes from five to forty amperes, with a glass lens mirror, or in cases where a perfectly straight beam of light is not a necessity, a plain parabolic reflector is furnished.

These lamps are made to operate on any direct current of high or low voltage. The feeding mechanism is of liberal proportions and the feed is not affected by the position of the light, which will work continuously in a vertical position, as when used for flashing signals on the sky when running in fog at night. This lamp is designed to meet the requirements of a marine light that will not easily get out of order, and of such construction that an ordinary mechanic can make repairs when necessary. A desirable feature in this lamp is that it takes full length carbons of twelve and seven inches, ensuring long running and economy of carbons The lamp presents a very handsome appearance and is made of brass or iron as desired, with copper trimmings. Other types of this lamp run as high as 200 amperes and have attachments for operating from the pilot house or at a distance from the glare of the light.

Financial Intelligence.

The Electrical Stock Market.

New York, September 15, 1894.

THE ELECTRICAL STOCK MARKET developed a deal of life during the past week, various important electrical legal decisions contributing to affect the prices of one or two different stocks.

GENERAL ELECTRIC was subjected to various attacks, the price going down on one day alone 2½ per cent., the presumption being that the company would suffer by the Court of Appeals' decision in favor of the Westinghouse Company. Great publicity has been given to this decision, and this has created an adverse sentiment against the Company. Its officers, however, insist that the importance of the decision has been overestimated. They claim that losing the case does not hurt General Electric at all, though winning it would have been of the greatest value. They explain this as follows: Long ago the United States Electric Company and the old Edison Company became involved in legal difficulties about the patents in dispute; pending litigation, it was agreed that both companies should manufacture under the patents involved. Afterwards the Westinghouse Company absorbed the United States Company and the Edison was merged into the General Electric Company, the old arrangement continuing. Had the General Electric won, it could have collected large royalties from other companies, but as the device has now been declared non-patentable, it will meet no further competition in its manufacture than it has all along had to contend with.

WESTINGHOUSE ELECTRIC issues naturally have been strong for the very reasons that combined to weaken General Electric's quotation. In the appeal from the lower courts' decision against the company for supposed infringement on a patented "electric distribution and translation system," the Westinghouse Company has gained all its points, so that its field of operations, according to official assertions, is greatly enlarged. The railroad department has been unusually busy of late; many large orders have just been contracted for, and the new works at Brinton, Pa., near Pittsburg, when once opened, will have enough to keep them in operation for months.

NORTH AMERICAN PHONOGRAPH COMPANY stock is becoming less valuable every day. As a result of the receivership at Newark, the Sheriff has taken possession of the company's premises in Chicago for non-payment of rent. It is freely stated that all the hostile steps are really directed by Mr. Edison himself, as he is understood to have an improved machine ready for market

WESTERN UNION TELEGRAPH stock holds up exceedingly well, and, in view of the showing of earnings just made, this is not to be wondered at. The directors this week declared the usual 1¼ per cent. quarterly dividend, and presented the following statement for the September 30 quarter, all figures partly estimated: Net revenue, $1,800,000; interest and sinking fund, $243,500; balance, $1,157,500; dividend, $1,192,000; surplus, $365,000; accrued surplus, $7,372,633; less for American Rapid Telegraph, $550,000; surplus, $6,822,633. The official comment on the purchase of the Rapid Telegraph Company is as follows: "Purchase of the telegraph lines and the property of the American Rapid Telegraph Company with 5,500 shares of capital stock issued out of the increased stock authorized by the stockholders on October 12, 1892, $550,000." The purchase saves $32,550 a year rental, and other benefits accrue to the Western Union Telegraph Company from the deal. About $4,500,000 of the surplus represents the treasury stock. The fiscal year ends June 30, and the annual report will be out next month. It will show about as follows: Net revenue, $5,792,483, as compared with $7,496,037 in 1893 and $7,398,547 in 1892; interest and sinking fund, $978,711; balance, $4,813,772; surplus, after dividend, $173,710, as compared with $1,930,840 in 1893 and $2,158,385 in 1892.

THE EDISON ELECTRIC ILLUMINATING COMPANY of New York, through Treasurer Joseph Williams, furnishes The Electrical World with the following figures of earnings and expenses: August gross earnings, $91,955, increase, $17,396; net earnings, $38,985, increase, $14,110; interest on bonds, $17,966, increase, $7,336. For eight months ending August 31, the company reports: Gross earnings, $866,358, increase, $101,069; net earnings $454,357, increase, $113,682; accrued interest on bonds, $135,399, increase, $38,695. In August the company had installed 196,872 incandescent lights, a gain of 36,339; 2,620 arc lamps, a gain of 547, and motors aggregating 7,080 horse power, a gain of 1,900.

THE BROOKYLN EDISON ELECTRIC ILLUMINATING COMPANY makes a similar by good showing for August. Gross earnings were $29,351, a gain of $11,680; net earnings, $9,341, increase, $4,639; total net income, $10,241, increase, $4,411; less interest and fixed charges, $2,100; applicable for dividends, $8,141, a gain of $4,411, or 118 per cent. increase. The regular quarterly dividend of 1½ per cent., payable October 15, has been declared.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¼	3
General Electric	100	38¾	39
General Electric pref		70	72
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35¼	36
" " pref	50	52¾	53

BONDS.

*Edison Electric Ill., New York	1,000	107½	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	204
American District Telegraph	100	42	49
American Telegraph & Cable	100	91½	92
Central & South American Telegraph	100	105	110
Commercial Cables	100	125	145
Erie Telephone	—	49	49¼
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
Western Union Telegraph	100	90⅞	91

*Ex-div.

New Incorporations.

THE MUTUAL TELEPHONE COMPANY, Fort Scott, Kas., capital stock $1,000, has been incorporated.

THE ELECTRO-MAGNETIC TRACTION COMPANY, Washington, D. C., capital stock $5,000,000, has been incorporated.

THE CANTON LIGHT, HEAT AND POWER COMPANY, Canton, O., capital stock $50,000, has been formed to supply electricity.

THE CITIZENS' ELECTRIC COMPANY, Middletown, O., capital stock $20,000, has been formed to furnish light, heat and power.

THE OHIO STORAGE BATTERY COMPANY, Cleveland, O., has been incorporated, with a capital stock of $1,000, to manufacture electrical devices.

UNITED TELEGRAPH, TELEPHONE AND ELECTRIC COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to operate telegraph and telephone lines.

THE NORWOOD CONSTRUCTION AND ELECTRIC COMPANY, Chicago Ill., capital stock $20,000, has been formed to build, construct and operate electric plants, railways, appliances, etc. E. D. Smith, N. Sampson and J. A. Low are interested.

THE CHARLES F. RICH COMPANY, Detroit, Mich., capital stock $20,000, has been formed to manufacture, buy and sell electric fixtures, etc. W. Boileau, Philadelphia Pa., Fred J. Linsell and C. F. Rich, of Detroit, Mich., are the organizers.

THE PHOENIX ELECTRIC LIGHT COMPANY, McKeesport, Pa., capital stock $5,000, has been formed to supply electricity for light, heat and power. J. E. Heinsman, W. S. McLain, Jr., Pittsburgh, and E. C. Johnson, Allegheny, Pa., are interested.

THE BLOCK LIGHTING AND POWER COMPANY, NO. 1, New York, capital stock $50,000, has been formed to manufacture electricity for producing light, heat and power. R. Stafford, A. M. Palmer and Edw. Lauterbach, New York, are the incorporators.

THE NORWOOD ELECTRIC LIGHT AND POWER COMPANY, Potsdam and Norfolk, N. Y., capital stock $5,000, has been formed to generate and sell electricity. G. W. Richards, W. D. Fuller, F. L. Smith and W. H. Wells, Norwood, N. Y., are interested.

THE MOMENCE ELECTRIC BALL STORAGE BATTERY COMPANY, Momence, Ill., capital stock $15,000, has been formed to manufacture storage batteries and other electric appliances. C. A. Smyth, L. Walker and F. E. Lane are the interested parties.

THE COALPORT-IRVONA LIGHT, HEAT AND POWER COMPANY, Coalport, Pa., capital stock $10,000, has been formed to supply light, heat and power to the public by electricity. R. A. Holden, A. P. MacLeod, Coalport; and J. E. McDowell, Irvona, Pa., are the promoters.

BROWN'S ELECTRICAL SUPPLY COMPANY, Minneapolis, Minn., capital stock $250,000, has been formed to manufacture electrical and mechanical appliances, attachments, machines, etc. C. D. Brown, W. H. Brown, and P. W. McAllister, all of Minneapolis, are interested.

THE AMERICAN ELECTRICAL HEATER COMPANY, Detroit, Mich., capital stock $5,000, has been formed to manufacture and sell electrical heating devices, cooking devices, dynamos, etc. The promoters are John Heffron, B. H. Scranton and F. H. Date, Detroit, Mich.

THE NORTHERN ELECTRIC PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric railway. A. C. Milliken, Pottsville; C. H. Davis and N. A. Waldorn, Philadelphia, Pa., are all interested.

THE TAMPA AND PALMETTO BEACH RAILWAY COMPANY, Tampa, Fla., capital stock $30,000, has been formed to build and operate a street railway, and also electric plants. R. W. Easley, W. H. Kendrick, and Louis T. Kendrick, Tampa, Fla., are the promoters.

THE ELECTRICAL ADVERTISING AND SIGN COMPANY, Portland, Me., capital stock $100,000, has been formed to manufacture and deal in electrical goods and apparatus of all kinds. C. L. Lacobe, E. R. Reynolds and J. V. Davis, New York City, are the incorporators.

THE READING AND POTTSTOWN ELECTRIC RAILWAY COMPANY, Reading, Pa., capital stock $100,900 has been formed to construct, maintain and operate an electric railway. The interested parties are K. A. Fitchthorn, R. L. Jones and M. C. Aulenback, Reading, Pa.

THE SOUTHWESTERN SUBURBAN RAPID TRANSIT COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to build and operate an electric or other railway, and to build and maintain electric plants. A. H. Minasian, N. Wilcoxon and F. M. Sherman are interested.

THE MIDDLETON ELECTRIC LIGHT AND POWER COMPANY, Middletown, O., capital stock $4,000, has been formed to generate and supply electricity for light, heat and power. E. H. McKnight, J. Schuer, W. J. Peters, G. S. Long, S. J. Miller and J. Henne are the interested parties.

THE LANCASTER AND SUSQUEHANNA RAILWAY COMPANY, Lancaster, Pa., capital stock $100,000, has been formed to construct, maintain and operate an electric street railway. J. S. Graybill, Lancaster; W. B. Given, Columbia, and H. L. Haldeman, Chickies, Pa., are the organizers.

THE CHICAGO, OAK PARK AND HARLEM STREET RAILWAY COM-

PANY, Chicago, Ill., capital stock $50,000, has been formed to build and operate railways, also electric light plants. J. C. Schumacher, Jr., J. Gnaedinger, G. A. Pudewa, F. Troost and H. D. Schumacher are the interested parties.

THE CHATEAUGAY ELECTRIC LIGHT AND POWER COMPANY, Chateaugay, N. Y., capital stock $6,000, has been formed to manufacture and use electricity for producing light, heat and power. E. A. Douglass, Mrs. M. A. Douglass, Hattie E. Douglass and A. S. Douglass are the incorporators.

THE MONTICELLO LIGHT, HEAT AND POWER COMPANY, Monticello N. Y., capital stock $20,000, has been organized to generate electricity and to sell electric light, heat and power. F. B. Hulse, Thompsonville, Meda E. Stone, New Brighton, and H. R. Hulse, New York City, N. Y., are interested.

THE OROVILLE GAS, ELECTRIC LIGHT AND POWER COMPANY, Oroville, Cal., capital stock $32,000, has been formed to deal in and operate electrical and gas works, etc. M. Marks, F. H. Gray, C. H. Shiveley, J. C. Osgood, C. W. Putnam, W. J. Schneider and W. E. Dunvan, Jr., Oroville, Cal., are interested.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 16, 1894.

MR. W. D. HILLS, of the Electric Inspection Department, of Chicago, was in the city last week.

MR. ELIASREIS, of the Ries Electrical Specialty Company, of Baltimore, Md., was in the city last week.

MR. H. H. CUTLER, Treasurer of the Cutler Hammer Manufactuirng Company, Chicago, was in New York last week.

MR. DILWORTH RICHARDSON'S address, which has formerly been St. Paul, Minn., is now 10 Wall street, room 45, New York city, and any mail addressed there will reach him.

MR. AUERBACHER, of the Automatic Specialty Company, New York, is now equipping the Central Park apartment building, New York, with central station synchronizing time system.

MR. HENRY B. OAKMAN, of New York, general Eastern agent of the Western Electric Company, reports the sale of two 80-kw. generators for the New York Industrial building. This is in addition to three Edison machines which have been running for some time.

THE BALL ENGINE COMPANY, Erie, has just placed two tandem compound engines, one 125 and one 175-h. p., in the station of the Greenwich Gas & Electric Light Company, Greenwich, Conn. These engines were furnished by J. W. Parker & Co., New York, representatives of the Ball Engine Company.

MR. HUGO REISINGER, 38 Beaver street, who is personally interested in the manufacture of the "Electra" Nurenberg high grade arc lighting carbons, is meeting with very gratifying success. Central stations which have adopted these carbons for arc lighting have found immediate improvement, which is attested by many testimonials.

MR. THOMAS AHEARN, of the firm of Ahearn & Soper, and president of the Consolidated Electric Light and Street Railway Company, of Ottowa, Can., arrived with his family on the steamship "State of Nebraska" last week from Europe, where they have been spending the summer. They left for Ottawa, all in fine health and spirits, the same evening.

THE AUTOMATIC ELECTRICAL SPECIALTY COMPANY has moved its office from the second to the third floor of the Electrical Exchange, into more commodious quarters. The former quarters had become too small and inadequate for the proper conduct of the continual growth of this company's business. Mr. Auerbacher, the head of this concern, reports that he has recently been awarded the contract for the complete installation of an electrical plant in Saenger Hall, Newark, N. J. This plant will consist of 2,000 incandescent lights, stage lighting, watchman's time detector system, Ball Wood engine and Edison dynamo.

NEW ENGLAND NOTE.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, September 8, 1894.

THE BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS has removed its office from 13 Beacon street to Rooms 144, 145 and 146 in the new State House Extension. Of the various entrances to the building only the northerly (Derne street) and the easterly (Bowdoin street) are open to the public, and the latter is not yet finished. Both these entrances are in the basement of the building, and the offices of the board are on the next floor above, in the west corridor.

News of the Week.

TELEGRAPH AND TELEPHONE.

WHEELING, W. VA.—The Peoples' Telephone and Construction Company will construct a telephone line, and are now in the market for wires, poles, insulators, etc. W. D. Johnson is the secretary.

WINCHESTER, KY.—The Winchester Telephone Company has been organized with R. P. Scobee, president, and C. H. Rees secretary and treasurer, to establish a city telephone system.

ELECTRIC LIGHT AND POWER.

CHICAGO, ILL.—Bids for the electric plant for the new Court-house will be received to September 26.

LANCASTER, PA.—The Borough Council decided at its regular meeting to light the town with electricity.

CUMBERLAND, MD.—The Cumberland Electric Light & Power Company is increasing the capacity of its plant.

ATHENS, GA.—R. L. Bloomfield is erecting an electric power house to supply power for the manufacturing industries.

WELLS, MINN.—The $20,000 water and electric light 5 per cent. bonds have been sold to Mason, Lewis & Co., of Chicago.

LANCASTER, O.—Address C. D. Hilles, secretary Boyer's Industrial School, regarding an electric light plant to be installed.

FLORENCE, COL.—The city has voted to grant a franchise to a Denver company to erect an electric light plant in Florence.

PENSACOLA, FLA.—The Citizens' Electric Light & Power Company has selected a site for its new plant and will erect same at once.

GAFFNEY, S. C.—The Gaffney Manufacturing Company will put in a new dynamo of sufficient power to supply lights for the city.

ST. HELEN'S, ORE.—St. Helen's will have an electric light system, a franchise having been granted for that purpose for 10 years.

BROOKLYN, N. Y.—The Brooklyn Gas & Electric Light Company has asked for a franchise under which it could operate in the city.

GETTYSBURG, PA.—The power-house of the Electric Light & Railway Company has been destroyed by fire, with a loss of $40,000.

GAFFNEY, S. C.—The Gaffney Manufacturing Company will put in a new dynamo large enough to enable it to supply the city with lights.

KALAMAZOO, MICH.—The Commercial Electric Engineering Company has been awarded the contract for erecting the electric light plant.

PORTLAND, ORE.—Address W. H. Merrick regarding a contract to be awarded for arc and incandescent lamps for a term of two years, commencing April 1, 1895.

CANTON, OHIO.—J. W. Wilder, of Cleveland, has received the contract for wiring the new City National Bank building with 405 lights on the three-wire system.

STEPHENSVILLE, TEX.—The City Council is considering several propositions for the erection of an electric light plant and water-works. Address the Mayor.

BELVIDERE, ILL.—Several machines at the electric light plant were burned out and nearly every telephone in town was more or less damaged in a recent storm.

PELZER, S. C.—The Pelzer Manufacturing Company is in the market for an electric power plant with which to operate its new cotton mill containing 48 spindles.

HALLOWELL, ME.—Address Johnson Brothers concerning estimates on the cost of an electric light and power plant for a shoe factory employing 400 operatives.

MT. VERNON, ILL.—Address F. Suddoth concerning a contract to be awarded for furnishing the city with not less than 30 nor more than 40 arc lights of 2,000 c. p.

VANCOUVER, B. C.—Address T. F. McGuigan concerning a contract to be awarded for an arc light plant of 200 lights, 2,000 c.p., and an incandescent plant of 42,000 lights.

POINT PLEASANT, N. J.—The availability of this place as a winter as well as a summer resort will be materially increased by the proposed extension of the trolley line to Lakewood.

MAMARONECK, N. Y.—The Larchmont Electric Company has contracted for its power station with the Berlin Iron Bridge Company. The station will be 50 feet wide and 90 feet long.

WAKEFIELD, MASS.—The town has voted to appropriate $20,000 of the bonds recently issued for extending and enlarging the municpal light plant. Judge E. A. Upton is Moderator.

WYTHEVILLE, VA.—A. C. Coulter and others have been awarded the franchise for the establishment of an electric light and power station, the power to be developed from the Reed River.

THE WASHINGTON ELECTRIC LIGHT, HEAT AND POWER COMPANY, Washington Court House, Ohio, desires to receive prices on a 75-kw. alternator that it is proposed to add to the plant.

TORONTO, CAN.—Address W. T. Stewart, chairman of the Committee of Fire and Light, concerning the contract for lighting the city with electricity for a period of five years, from January 1, 1896.

ST. JOHN'S, MICH.—The question of public lighting is just now being discussed by the Common Council—whether or not the street lighting shall be done wholly by electricity, or electricity and gas, as now.

SOUTH MILWAUKEE, WIS.—The Electric Light Committee, of the South Milwaukee Village Board will report in favor of, purchasing the Williams & Mansfield lighting system, rather than pay $100 each for arc lights.

ALLEGHENY, PA.—The Western Electric Company has been awarded the contract for the electric light plant for $70,769.70, providing that Director McAffee examines the bids and finds the figures the same as those of the committee, and if not, the contract will go to the lowest bidder.

WHITEHALL, ILL.—At a meeting of the City Council the contract with the Green County Electric Light Co. was declared void, it having expired by limitation. A bid to furnish lights at the rate of $60 per year for each 1200 candle power lamp was submitted by Mr. Gleason, of Chicago, and was referred to the Committee on Electric Lights.

PENSACOLA, FLA.—At a meeting of the directors of the Citizens' Electric Light & Power Company, it was decided to purchase the Hudson property between Palafox and Main streets, as a location for its plant. It was also decided to begin operations at once, and an order for the machinery will be given as soon as the details are decided, which will be at an early date.

The Electric Railway.

LUDINGTON, MICH.—The Council granted a franchise for an electric railway.

MERCED, CAL.—An electric road is to be built from this place to the Seth Cook gold mines.

MEDIA.—Experts have begun the work of locating the trolley line between Media and Newtown Square.

NEWARK, N. J.—The people are desirous of having a double track rapid transit road built to Franklin.

KNOXVILLE, TENN.—Clark Rude has been authorized to build an electric road in the city. Charles J. Pogue is his local representative.

TACOMA, WASH.—Frank C. Ross is again agitating the proposition to construct an electric railway from this city to Sumner and Puyallup.

GREEBVILLE, TEX.—J. O. Adams and others have secured the right-of-way for an electrical railway which a company now organizing will build.

NEW BRUNSWICK, N. J.—Two railroad companies have asked privileges of the city at the meeting of the Board of Aldermen for a street railroad here.

OCEANPORT, N. J.—The prospect of having an electric railroad from Long Branch to Red Bank, connecting at this place, is now almost an assured fact.

OPELIKA, ALA.—Construction work has been begun on the electric road from Opelika to Auburn. John L. Cowan is one of the principal interested parties.

CORTLAND, N. Y.—The board granted the application of the Cortland & Homer Street Surface Railway Company for permission to use electric power in operating its road.

MANCHESTER, N. H.—The Committee on Electric Street Railways will meet to discuss the matter of an electric road, and will probably make some recommendations to the board.

SOMERVILLE, N. J.—After two months' contest the Council of Somerville has granted the right-of-way through the main street to the New York & Philadelphia Traction Company.

NEW ALBANY, IND.—An electric line bewteen New Albany and Wyandotte Cave is being agitated by the citizens of Corydon and Leavenworth. Judge G. B. Cardwell is interested in the project.

PORT CHESTER, N. Y.—A proposition is under way to build an electric road from Glenville by way of King street to Port Chester and from Byram bridge to the Mamaroneck bridge with a spur to Rye Beach.

BANGOR, ME.—The latest scheme on foot is an electric railroad running from Bangor through Veazie, Basin Mills, Orono, Great Works, Old Town, Still Water, thence to Newcom's Landing and Bangor.

VERONA, N. J.—The Verona Town Board unanimously passed an ordinance giving the North Jersey Street Railway Company a franchise to contruct and operate an electric road through Verona township.

WASHINGTON, D. C.—The Columbia Railway power-house, for which proposals will be asked for in a few days, will soon be erected. When the contract is let work on the plans for the car-house will be commenced.

NEW PALTZ, N. Y.—It now looks as if the New Paltz & Highland Electric Railroad would be built after all, a contract having been made with Philadelphia parties to build it. Mr. Van Steenburg is Superintendent and Track Master.

NEW BRITAIN, CONN.—Surveyors from New Britain, representing the electric railway company there, were in Newington and surveyed a new route which makes the distance between Hartford and New Britain 8 miles instead of 9, as by the other company's survey.

CHARLOTTESVILLE, VA.—The consolidation of the Charlottesville & University Street Railway Company, with the Charlottesville University Electric Light Company and the equipment of the street railway with electricity, is proposed. R. P. Valentine can give particulars.

BINGHAMTON, N. Y.—The Binghamton Street Railroad Company has received permission to double the track on the lower portion of Washington street, De Russey street, from the south end of the bridge to Vestal avenue, and a portion of Vestal avenue and Park avenue to Rose Park

CRISFIELD, MD.—The Somerset Electric Light and Street Railway Company chartered by the last legislature, is perfecting its organization and will shortly be in the market for an electrical equipment. Thomas S. Hodson, 6 East Lexington street, Baltimore, may be addressed in regard to same.

WHITE PLAINS, N. Y.—Application has been made to the Highway Commissioners of the town of Greenburg by the White Plains, Elmsford & New York Railroad Company for the right to construct an electric railroad on the Tarrytown and White Plains road, from White Plains to Elmsford.

PITTSBURG, PA.—The company which received permission to construct an electric railway from Pittsburg to Kiskiminetas has received right-of-way to construct their line through Freeport, Tarentum, Natrona, Springdale, Hites, Aspinwall and Sharpsburg. S. H. Hicks, of Philadelphia, is interested.

NEWARK, N. J.—The Consolidated Traction Company will erect a one-story brick power station, 191x155, on River street. The plant will be equipped with 32 boilers, having a combined horse power of 6,000, six engines of 1,000-horse power each, a mammoth traveling crane and modern electrical machinery. The estimated cost is $400,000.

FORT WORTH, TEXAS.—The Polytechnic Street Railway has been sold to Messrs. R. Vickery, S. S. Ash and George Tandy. The company has applied for a new charter, and will be incorporated as the Glenwood & Polytechnic Street Car Company. As soon as possible the road will be extended to the Polytechnic College campus and also into the city.

PHILADELPHIA, PA.—Plans were approved by the Building Inspectors for the power station to be erected on the site of McBride Bros.' old coal wharves, Twenty-fifth and South streets, for the Electric Traction Company. The structure will be of stone and iron, 141x90 feet, and will be built on driven piles. There are to be four engines and four boilers in the building, which, with the machinery, will cost about $225,000. Charles McCaul has the contract, and he will begin work at once.

FRANKLIN, PA.—Before the end of the present month, it is announced, the Electric Traction Company expects to commence running trolley cars on its Fifth and Sixth street line. The contract for the extension to Franklinville has been awarded, and, as the plans have been approved by the Highway Supervisors, work is to commence immediately. The contract for the laying of the rails has been awarded to Contractor Shields, and Councilman R. C. Horr will do the paving. Senator Charles A. Porter has the contract for laying the track on Baltimore avenue, from Thirty-ninth street to the city line at Angora.

PHILADELPHIA, PA.—At the monthly meeting of the Park Commissioners on Saturday, Mr. Sellers offered a resolution, which was adopted, authorizing the Committee on Plans and Improvements to ascertain the cost, etc., of laying a double track passenger railway, to be operated by the trolley system, on the west side of Belmont avenue north from Elm avenue, to connect with the tracks of existing railway companies, the owners of which shall agree to pay a proportionate share of the cost of maintenance, and to fix the fare not beyond two cents.

Miscellaneous Notes.

PROF. A. L. M'RAE has resigned his chair in the Missouri School of Mines to accept the chair of Physics in the University of Texas.

DR. PAUL SCHOOP, Zurich, Switzerland, has undertaken the translation into German of Prof. H. S. Carhart's work on Primary Batteries, and will also add a chapter on secondary batteries.

STORAGE BATTERY LITIGATION.—The Accumulator Company has filed preliminary papers for a motion of injunction against the Edison Illuminating Company, of New York, to enjoin the use of the chloride accumulator installation. The case came up on the 11th inst. before Judge Lacombe, but was postponed owing to the absence of counsel until next motion day.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its eighty-ninth meeting at 12 West Thirty-first street on September 19 at which a paper on "A Study of the Residual Charges of Condensers and their Dependence Upon Temperature," by Dr. Bedell and C. Kinsley, will be read by title and discussed, and another by E. A. Sperry, on "The Electric Brake in Practice," will be read and accompanied by practical demonstrations.

A SUGGESTION FOR THE FASTIDIOUS.—A correspondent suggests that for the benefit of those users of the telephone who object to the word "hello," the word "tel-ho" be substituted, a combination of the terms "tel" and "ho," each being clearly defined by Webster, and meaning in this connection, "A call or reply to excite attention at a distance." We can here have a word with a meaning befitting its use, and which is quite similar in sound to that meaningless term "hello."

ELECTRICAL ENGINEERING LECTURES.—A course of twenty-five lectures on "Electrical Engineering," by Mr. Max Osterberg, E. E., graduate of Columbia College, will be given on Saturday evenings, beginning October 6, 1894, in the Young Men's Christian Association Building, corner Twenty-third street and Fourth avenue. Tickets, $6.00. For further information apply to Educational Secretary Waldo H. Sherman, 52 East Twenty-third street, or to Mr. Osterberg, 232 East Sixty-second street, on or before October 1, 1894.

MOORE, EDISON AND TESLA.—The Pittsburgh Despatch prints a syndicate article on a storage battery bicycle, entitled "A Revolution in Wheeling," illustrated with a portrait of Mr. D. McFarlan Moore, from which we extract the following: "And of all the men who have devoted their knowledge to this aspect of motive energy, D. McFarlan Moore has, probably, attracted most attention. This young man is, indeed, as remarkable from the human point of view as is his science from a physical aspect. Edison himself takes no small amount of pride in his rising pupil's achievements. There is hardly a detail of electrical science which he has not at his finger tips. His discoveries in the possibilities of molecular vibration as a source of electric illumination, have recently attracted attention in two continents. In the application of old principles to new uses he has made Edison's fame as a teacher equal to the renown of his name as an inventor. With Nikola Tesla he divides the allegiance of the electrical world as the rising sun of science. Although in the twenties, Mr. Moore's name is a part of the vocabulary of every student of electricity."

YOUNG MEN'S INSTITUTE OF THE Y. M. C. A.—There will be special exercises at the Young Men's Institute, 222 Bowery, New York, Tuesday, October 2, to formally open the Educational Department of the work. There will be music and short addresses in the large hall, and all the class rooms will be open for the inspection of the visitors. An excellent educational work is being done by the institute each year. Instruction is given in the following subjects: Steam Engineering, Practical Electricity, Sanitary Plumbing, Carriage Drafting, Mechanical Drawing, Architectural Drawing, Free-hand Drawing, Arithmetic, Book-keeping, Penmanship, Shorthand, Typewriting, English Grammar and Composition, Vocal Music and Glee Club, and First Aid to the Injured. The classes are open to all young men between the ages of 17 and 35 years. A distinctive feature of this educational work is that the theory is taught to those who are getting the practical part of the subject in their daily work. Firemen are taught all the theory necessary for becoming engineers. Engineers are prepared to take charge of higher grade engines. Machinists are taught the mechanical drawing which they need in their work. Young men in offices are taught commercial subjects. In this way the efficiency and commercial value of each student is increased for his present employer. The enrollment for the season of 1893-94 was 425 young men. The quality of work done has shown a decided improvement each year. The school year continues until May, when diplomas and prizes are awarded by the Committee of Management. Admission is free to the opening exercises on October 2.

Trade and Industrial Notes.

THE IONA MANUFACTURING COMPANY, 536 Congress street, Boston, has issued a price list, No. 3, dated September, 1894, of its well-known line of electric lighting specialties, watchmen's electric time registers, electro-mechanical gongs, etc.

THE NATIONAL CONDUIT MANUFACTURING COMPANY, Times Building, New York, has received an important contract from the West Chicago Street Railway Company. The contract is a very large one and the company naturally feels elated at having secured it in direct competition with all other styles of conduits.

THE COOPER-ROBERTS COMPANY, Mt. Vernon, Ohio, sends us a copy of its neat 1894 catalogue, which illustrates and briefly describes the improved, high speed, self-contained centre crank, automatic Cooper engine. The pamphlet is tastefully gotten up and well printed, and the wood engravings very plainly show all of the details.

H. B. COHO & COMPANY, 203 Broadway, New York, report the sale during the past week of three machines aggregating 110-h. p., to the Henry R. Worthington Company, for use in their Brooklyn works. Also three generators and five motors, aggregating 300-h. p., to Messrs. Nardi, Strang & Company, Philadelphia, for use in the new Odd Fellows' Hall, that city.

THE BALL ENGINE COMPANY, Erie, Pa., has the contract for furnishing the engine for electric lighting in the new Industrial Home for the Blind in the city of Chicago. This engine is to be direct connected to an Edison dynamo. Though Mr. Pashall, Detroit representative of the company, it is installing a 70-h. p. engine in the building of the Edison-Moore Company, Detroit.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is building a large addition to the machine shops of Henry R. Worthington, at Brooklyn, N. Y. The Berlin company has also received the contract for an annealing room building for the Naugatuck Malleable Iron Company, at Naugatuck, Conn. The building is 94 feet wide and 175 feet long, with brick walls and iron roof trusses covered with corrugated iron.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is warning the public against an imitation of the Packard lamp, which is now being offered to the trade with the statement that it is the Packard or just the same as the Packard but without the label. The company states that no lamps are genuine unless they bear the Packard trademark and are purchased from authorized agents of the Packard Company or the Electric Appliance Company.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., reports as a sign of the revival in the electrical business, the closing in three consecutive days last week of contracts for more than 1,500-horse power of its standard apparatus, consisting of direct connected and belted generators and their Manchester type slow speed motors. This, with the other work the Mather Company now has on hand, will compel it to at once increase its working force, although part of its works is now being operated at night.

THE CHESLEY ELECTRIC COMPANY, Hoboken, N. J., reports business brisk, and state that they have recently finished some large contracts for street railway specialties. They are repairing several large armatures and have excellent facilities for handling heavy work, as this department is located on the ground floor. An unusual feature of this company's business is the fact that its factory is never closed. This is done to accommodate its customers who may have a break-down requiring immediate attention. It is at present making some alterations on its building which will give more room.

THE DALE MANUFACTURING COMPANY, 22 Cortlandt street, New York, in a handsome 48-page catalogue, illustrates a large line of material such as may be daily required by operators of electric lighting and power plants, electrical contractors and wiremen. A number of pages are devoted to electrical fixtures and shades of standard and special patterns, and a very full line of various fittings follows. The catalogue will be found useful by the electric light man, as the matter has been selected with a view to the requirements of every day work, and therefore the pamphlet has not been padded out with all manner of cuts and prices that would detract from its value rendering reference less easy.

THE HARRISBURG FOUNDRY AND MACHINE COMPANY, Harrisburg Pa., sends us three luxurious specimens of catalogue making. One is a 11x16 20-page catalogue of the Harrisburg double engine steam road roller, beautifully printed on an extra fine quality of paper and illustrated with a large number of Bartlett engravings. Another consists of eight 9¼x11¾ cards enclosed in a stiff envelope. Each card contains an engraving of a type of the Ide engine, surrounded by a colored border, in one corner of which is a suggestive sketch; each card has also embossed in a corner the handsome trade-mark of the company. The third is a small 16-page catalogue of the Ide engine, in which each cut is surrounded by a handsome border, there being several designs of these. With such patrons as the Harrisburg Foundry and Machine Company, and the firm of Bartlett Company as artists, engravers and printers, catalogue making is approaching a fine art.

WARREN WEBSTER & COMPANY, Camden, N. Y., specialists in examining steam plants where economy in fuel is desired, and utilizing the waste exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures in comparison with other standard apparatus for similar purposes. Among the recent contracts for the Webster "vacuum" feed water heater and purifier in connection with electric plants, they mention: B. & O. tunnel plant, Baltimore, Md., 3,000-h. p.; Westinghouse Electric and Manufacturing Company, Brinton, Pa., 2,500-h. p.; Berwick Electric Light Company, Berwick, Pa., 250-h. p.; Cincinnati Street Railway Company, Cincinnati, O., 1,000-h. p.; Arapahoe Street Railway Company, Denver, Col., 150 h.-p.; Chicago Edison Company, North Side Station, Chicago, Ill., 2,000h-. p., and 3,000-h. p. to the Johnson Company, Lorain, O. In a number of the above contracts the equipment of standard makes of feed water heaters was removed. Numerous orders were also received for the Webster separators and the Williams vacuum system of steam heating.

E. W. BLISS & CO., 17 Adams street, Brooklyn, reports that its European business has been very large recently. It shipped to Switzerland within the last two months a special watchmaker's drop hammer and several punching presses fitted with sub-presses for watch work; also a No. 1½ toggle drawing press. A large shipment was sent to Germany to one of the largest clock-making concerns in the world, of tools and machinery for the manufacture of clocks and their cases. France has also received a large shipment of tools for the making of granite enamel ware and kitchen utensils, and for several watch factories. Austria has not been behind the others, as she has also received a No. 1½ and 3½ toggle drawing press, No. 18, 19, 20 and 21 adjustable power presses, and No. 36½ and 39 power presses with a number of dies, and a No. 161 double action press with dies and special feed, for making primers. A large improved automatic perforating press is now nearly completed and will be shipped to England for the manufacture of perforated metals up to 50" in width. This speaks well for American tools in competiiton with those of foreign make.

THE BALL ENGINE COMPANY, Erie, Pa., sends us another list of its recent shipments of engines, although it is only a few weeks ago since we reported a long list. The list of shipments is as follows: Peninsula Light & Power Company., Houghton, Mich., one 350-h. p. tandem compound engine; Union Colliery Company, Victoria, B. C., one 160-h. p. engine; Edison, Moore & Co., Detroit, Mich., one 80-h. p. engine; Noyes, Norman & Co., St. Joseph, Mo., one 80-h. p. engine; City of Adrian, Adrian, Minn., one 70-h. p. engine, direct connected to a Siemens-Halske dynamo; J. W. Parker & Co., New York city, one 50-h.p. engine; Celedon Terra Cotta Company, Alfred Centre, N. Y., one 100-h. p. engine; Norton Bros., Chicago, Ill., one 150-h. p. cross compound engine; Berwick Electric Light Company, Berwick, Pa., one 160-h. p. engine; Sol Heyman & Co., New York City, one 60-h. p. engine; North Sub-district School, Fourth Ward Pittsburgh, Pa., one 35-h. p. engine; Geo. W. Childs' Public School Building, Philadelphia, Pa., one 60-h. p. engine; E. P. Dodge Manufacturing Company, Newburyport, Mass., one 50-h. p. engine; J. W. Parker & Co., New York City, for export, one 30-h. p. engine.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

CHARACTERISTICS OF A POPULAR RAILROAD—Travelers find unexcelled accommodations and supreme comfort on the cars of the New York Central Railroad. American railways are noted for the advantages which they afford the traveling public, and there are none that surpass this splendidly equipped road.—"Paper Trade Journal."

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 11, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York).

525,689. ELECTRIC TRANSFORMER; C. S. Bradley Avon, N. Y. Application filed August 22, 1891. This comprises a series of superposed laminæ of iron provided with two openings for the coils with an intervening web of iron, the wires constituting the coils being threaded through the openings and united at the ends so as to form a continuous circuit.

525,690. ELECTRIC RAILWAY SYSTEM; C. S. Bradley, Avon, N. Y. Application filed January 2, 1894. This comprises plurality of alternate current generators organized to impose on line currents of different frequency, distributing lines supplied thereby, and alternate current motors connected with the distributing lines.

525,697. WINDING FOR DRUM ARMATURES IN DYNAMO MACHINES; R. Eickemeyer, Yonkers, N. Y. Application filed March 9, 1892. This comprises independent coils, each having a long and a short side lying along the periphery of the drum and inclined ends lying across the end of the drum.

525,698. ARMATURE FOR DYNAMO ELECTRIC MACHINES; R. Eickemeyer, Yonkers, N. Y. Application filed April 13, 1894. A bipolar armature winding composed of rectangular coils assembled in groups, and having the ends of the coils in each group equally divided and located at opposite sides of the armature.

255,704. ELECTRIC CLOCK; F. L. Gregory, Chicago, Ill. Application filed January 30, 1894. This comprises a reciprocity member, a circuit-closer actuator, a circuit-closer carrier, a circuit-closer thereon adapted for limited movement independently thereof, and an electrical terminal in the path of the closer.

525,708. BUS BAR INSULATING SUPPORT; A. B. Herrick, Schenectady, N. Y. Application filed April 11, 1894. This comprises an L-shaped section for an insulating block formed with a transverse passageway for a conductor on the inner face of the long and short arm of the L-shaped piece, and with means on the outer face for securing the section in a frame.

525,735. ELECTRIC ARC LAMP; S. L. Campbell, Kalamazoo, Mich. Application filed January 23, 1894. This comprises a rocker frame composed of two pieces, combination coils, and suitable means of retaining the pieces together.

525,730. ELECTRIC FAN; C. Wachtel, Newark, N.J. Application filed January 17, 1893. This comprises a frame and fan shaft, an armature carrier on the shaft, consisting of a plate, sleeve and set crews thereon, lugs on the lower side of the plate and an armature secured to the lugs.

525,579. SYSTEM OF ELECTRICAL DISTRIBUTION; J. F. McElroy, Lansing, Mich. Application filed October 5, 1887. This comprises an electrostatic converter having its members separated by a dialectric, the thickness of which causes the fall in potential.

525,779. SYNCHRONIZING MECHANISM FOR ELECTRIC CLOCKS; E. Ayres, Sydney, New South Wales. Application filed October 7, 1893. This comprises a pair of pivoted arms, one of which constitutes the armature of a magnet, each provided with means for closing an electric circuit, the armature lever having a lateral extension underlying the other arm, whereby, when the armature is attracted by the magnet, it will be caused to lift the other arm and break the circuits.

525,789. TROLLEY POLE CONNECTION; M. R. and J. M. Crane, Newark, N J. Application filed November 10, 1893. This comprises a frame adapted to connect with the socket and having a hollow bridge or way, and an arm

connecting with the pole and pivotally secured to the holder and working in the bridge or way.

525,782. COMBINED BRAKE AND ELECTRIC SWITCH FOR STREET RAILWAY CARS; G. Brown, Long Island City. This comprises the car brakes, and a plurality of switches adapted to gradually increase or decrease the current, and means for applying or releasing the brakes, and actuating the switches successively at the same movement.

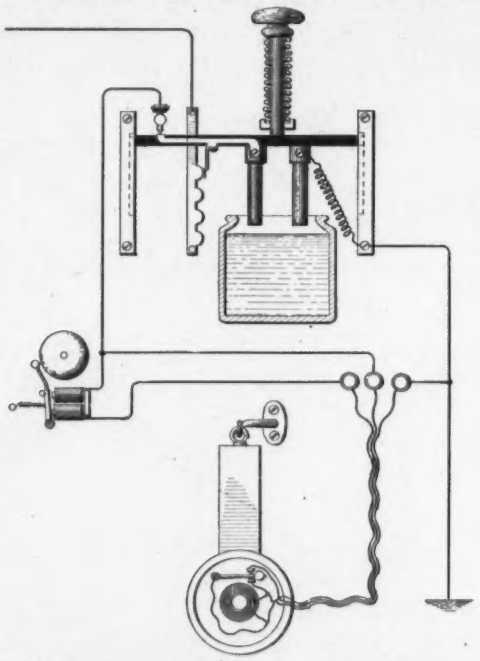
525,836. SELF-ADJUSTING BRUSH FOR DYNAMO ELECTRIC MACHINES; W. L. Bliss, Brooklyn, N. Y. Application filed April 13, 1894. This comprises a pivotal support upon which the brush carrier is fitted to rotate freely in either direction, and a fixed stop against which the brush carrier, rotated by the friction of the commutator on the brushes, is positively arrested in either direction to stop the brushes in positions the reverse of that which they occupy when the carrier is arrested in the opposite direction.

525,840. LIGHTNING ARRESTER; A. L. Courtright, Keokuk, Ia. Application filed February 1, 1894. This comprises two similar adjustable sections, each section composed of a non-conducting base, copper plates secured on each side thereof, a binding post projected through the copper plates, and insulating material with means for securing it therewith and electrodes in contact with both of the copper plates.

525,864. ELECTRIC RAILWAY; H. E. Rider, New York, N. Y. Application filed February 26, 1894. This comprises an arm having upwardly projecting branches and current collectors carried thereby and insulated therefrom and arranged to move in contact with the conductors.

525,866. ELECTRICAL SIGNALING APPARATUS FOR RAILWAYS; P. Schwenke, Zerbst, Germany. Application filed April 8, 1892. This comprises a line circuit, a circuit breaker and relay, a signaling circuit, an electromagnet arranged in the signaling circuit, an armature pivotally arranged adjacent to the electro-magnet, a gear wheel mounted on the pivot of the armature, and a pivoted semaphore provided with a rack in engagement with the gear wheel.

525,874. ELECTRIC ANNUNCIATOR; H. C. Thomson, Boston, Mass. Application filed July 2, 1894. This comprises an index finger, a couple of



No. 525,703.—Telephone Call System.

helices so arranged as to admit of one armature core sliding between the two, a sliding armature core so arranged, and a rod running at right angles through the armature core.

525,886. TROLLEY FOR ELECTRIC RAILROADS; E. Dawson, Terre Haute, Ind. Application filed December 26, 1893. This comprises a socket, two brackets secured thereto and provided with screw-threaded bosses at their upper ends, and a hollow pin screwed upon the bosses and forming the bearing for the trolley wheel.

525,891. FASTENER FOR ELECTRIC WIRES; H. C. Fricke, Pittsburg, Pa. Application filed June 14, 1894. This comprises an insulating piece bent in the form of a cylinder when closed and having radially projecting edges.

525,888. MANUFACTURE OF CARBONS FOR ELECTRIC LAMPS; T. A. Edison, Menlo Park, N. J. Application filed March 20, 1880. A conductor for an electric lamp formed of a carbonized natural fiber of endogenous growth and made up of parallel elementary fibers.

525,894. RECORDING VOLTMETER; F. D'A. Goold, Schenectady, N. Y. Application filed April 16, 1892. This comprises a coil and armature, three levers, a connection between the centre of the first lever and the armature, a marking point connected to the central point, and a regularly movable surface on which the point is adapted to bear.

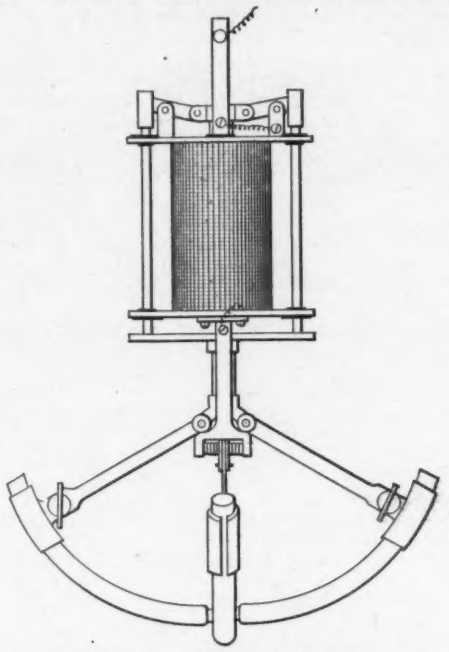
525,909. INCANDESCENT LAMP STAND AND REFLECTOR; G. P. Klemm, Philadelphia, Pa. Application filed June 9, 1894. This comprises a base, a supporting arm connected thereto so as to secure a reciprocatory motion, a slotted tube, a hanger attached to the middle thereof, and a knuckle joint connection between the supporting arm and hanger.

525,943. ELECTRIC ARC LAMP; H. E. Bradley, New Bedford, Mass. Application filed February 28, 1894. This comprises a lamp frame, feed rod, tilting lever, and main and shunt magnets arranged to tilt the lever and operate the feed rod, a cut-out comprising a spring plate secured to the lamp frame, a rod connecting the lever to the spring plate, and a relatively stationary plate arranged in the path of travel of the spring plate.

525,945. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; W. G. Creighton, Chicago, Ill. Application filed February 28, 1894. This comprises a track rail, a plate forming a conduit therewith and having a grooved portion overhanging the rail, and a slot closer in the groove and adapted to rest upon the rail edge.

525,992. SYSTEM OF LIGHTING AND HEATING CARS BY ELECTRICITY; M. Moskowitz, Newark, N. J. Application filed March 31, 1894. This comprises a working circuit, a dynamo, a pair of storage batteries and a switch for connecting either of the batteries with the dynamo.

525,993. MEANS FOR EQUALIZING ELECTROMOTIVE FORCE OF DYNAMOS; M. Moskowitz, Newark, N. J. Application filed June 15, 1894. The combination of a generator, and a combined motor and regulating dynamo,



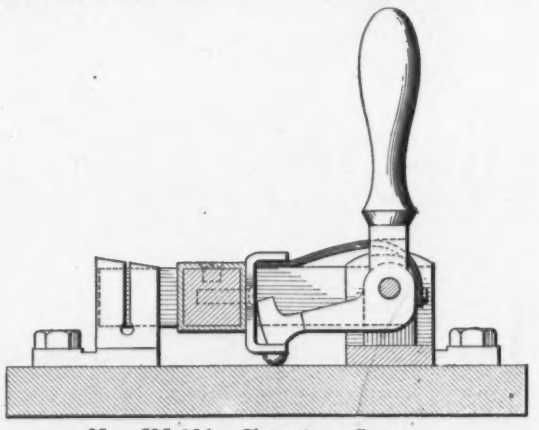
No. 525,743.—Electric Arc Lamp.

the armature circuit of the regulating dynamo being in circuit with the magnetic fields of the generator.

526,016. ELECTRIC MOTOR; J. S. Losch, Summit Station, Pa. Application filed March 6, 1894. The combination with a commutator, of a brush provided with ribbed or flanged ends, whereby a greater wearing surface is provided and the brush is more readily retained in position.

525,702. TELEPHONE CALL SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. Application filed November 27, 1893. This comprises a telephone with a fixed attachment to connect the same with a support, and a resonator so related to the support that when the telephone is on the support the diaphragm will be close to the resonator.

525,703. TELEPHONE CALL SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. Application filed January 11, 1894. This comprises a normally closed



No. 525,936.—Electric Switch.

circuit including a call receiving instrument, a dip battery for transmitting calling current, and connections for opening the circuit and cutting in the battery during immersion of its electrodes.

525,743. ELECTRIC ARC LAMP; A. B. Roney, Chicago, Ill. Application filed March 7, 1894. This comprises two pairs of carbons, each pair feeding to a common centre, one of the pairs being mounted in a movable framework and electro-magnetic means for forming and maintaining the electric arc between the two pairs of carbons.

525,936. ELECTRIC SWITCH; G. Baehr, Jersey City, N. J. Application filed January 9, 1894. The combination of a pair of circuit controlling blades, a cross-bar of insulating material mechanically connecting them together, a pair of jaws carried by the cross-bar, a manually operated swinging lever provided with an extension which is loosely embraced by the jaws and a spring bearing at one end against the lever and at the other end against the cross-bar.